Motorship

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EXCLUSIVE technical and non-technical articles on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

(Trade Mark Registered)

PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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Diesel Engine Contracts of Shipping Board Exceed $4,000,000

Government's Ship Conversion Program Is Launched With Orders for 18 Engines Totaling 50,000 s.h.p and in Line With the Most Advanced Motorship Practice

EARLY last month announcement was made by the Shipping Board that it had approved an expansion of the first section of its program for a motorship fleet and would proceed with the conversion of six more vessels than had originally been contemplated, making a total of eighteen. Notification was sent to bidders whose tenders had been considered favorable that the Board was ready to place contracts on a revised basis. The bids had been received by October 14th and within the short period of three weeks considerable negotiations had been carried on with the bidders and terminated with results considered by the Board and the contractors to be as satisfactory as possible.

The results obtained by the Board are well evidenced by a comparison between the tabulated awards on the next page and the summary of the bids published in our last issue.

Orders for the eighteen engines have been distributed among seven firms, calling for both single-acting and double-acting engines of the two-cycle and four-cycle types. Averaging about 2,900 shaft h.p. these sets, which are all for installation in single-screw vessels, are more powerful than all except a very few of the latest constructed on the other side At the present time there are not in service half-a-dozen single-screw motorships of greater power than the converted vessels of the Shipping Board will be. During the period of more than a year and a half which will elapse before the conversions are completed, this situation will change slightly. It is certain, however, that when the Shipping Board's motor vessels go into commission they will be abreast of the leading practice of any other country and ahead of most. It is only when the Shipping Board's program is considered with this feature prominently in mind that the importance of the Government's first big order can be properly appreciated and the responsibilities that face the successful bidders can be maturely weighed.

One of the principal differences between the bids and the awards is disclosed in the column of engine prices. Citing average figures, which are more useful for this purpose than individual engine figures, it is notable that the awards have been made on a basis of about $235,000 per engine, whereas the bids ranged around an average of some $290,000.

So unusual is it for such a reduction to occur in the award of public contracts that considerable discussion has been aroused, and is still continuing, on the points of law and ethics supposedly involved. As a matter of fact, the position of both the engine builders and the Government department concerned in the case can be elucidated by a recital of the obstacles that had to be surmounted before the contracts could be placed.

An outline of the situation that seems to have faced the Shipping Board before its negotiations with the engine builders shows that for a time the whole Government program was in jeopardy. Confronted with this situation the manufacturers co-operated wholeheartedly with the Government to achieve a solution that would enable the program to be started.

Surprising as it may seem, nevertheless, it is a fact that the trouble originated from a clause inserted by Congress in "The Ship Conversion Act." We find namely in Section 2 of that Act the following stipulation:

"Any such vessel hereafter so equipped by the Board under the provisions of this section shall not be sold for a period of five years from the date the installation thereof is completed, unless it is sold for a price not less than the cost of the installation thereof and of any other work of reconditioning done at the same time plus an amount not less than $10 for each deadweight ton of the vessel as computed before such reconditioning thereof is commenced."

This provision was inserted during the later stages of the progress of the Bill through the Congressional Committee, in accordance with what seemed good and sufficient reasons which need not be discussed here because they do not affect the narrative. What Congress did not foresee was that this provision might prove the undoing of the very purpose of the Act itself. It came perilously near wrecking the conversion program at the start.

When the bids were taken under review immediately after they had been publicly opened on October 14th, it became apparent that when the total cost of conversion was added to the cost of the engine and the additional $10 per ton required by Congress were imposed on that total, the price of the converted ships would exceed the figure at which they could reasonably be expected to sell in the open market.

The market price for vessels is determined by international conditions, and, short of another important war in some part or other of the world, or failing some entirely unforeseen change of world trading conditions, the Shipping Board could not contem

The Spirit of the Engine Builders

AN outline of the situation that seems to have faced the Shipping Board before its negotiations with the engine builders shows that for a time the whole Government program was in jeopardy. Confronted with this situation the manufacturers co-operated wholeheartedly with the Government to achieve a solution that would enable the program to be started.

Analysis of Diesel Engine Awards Made by the U. S. Shipping Board

Type of Engine		*Name*	*No. of Engines*	*Power Each*	*Price Each*	*Price Per S.H.P.*	*Deliveries*
Single-acting	4-cycle	Cramp's	4	2,800 s.h.p.	$255,000	$91.07	11-15mths.
		McIntosh & Seymour	3	2,700 s.h.p.	$222,435	$82.38	10-14½mths
		Pacific Diesel	2	2,900 s.h.p.	$225,000	$77.58	8-10mths.
	2-cycle	Busch Sulzer	4	3,000 s.h.p.	$250,000	$83.33	14-20mths.

Averages Single-acting
Average power per engine 2,850 *s.h.p.*
Average price per engine $241,331
Average price per s.h.p. $84.70

Type of Engine		*Name*	*No. of Engines*	*Power Each*	*Price Each*	*Price Per S.H.P.*	*Deliveries*
Double-acting	2-cycle	Worthington	2	2,900 s.h.p.	$210,357	$72.53	9-11mths.
		Hooven-Owens	1	3,050 s.h.p.	$225,000	$73.77	14mths.
		New London	1	3,000 s.h.p.	$235,000	$78.33	16½mths.
	4-cycle	McIntosh & Seymour	1	2,700 s.h.p.	$222,435	$82.38	10mths.

Averages Double-acting
Average power per engine 2,910 *s.h.p.*
Average price per engine $220,630
Average price per s.h.p. $75.80

Prices have been reduced to a comparative basis, suitable allowances being made in the cases of engines that do not have attached air compressors.

AVERAGES ALL ENGINES
AVERAGE POWER PER ENGINE 2,870 s.h.p.
AVERAGE PRICE PER ENGINE $235,582
AVERAGE PRICE PER S.H.P. $82.10

All averages are derived from the totals, which are omitted from the above tabulations.

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plate any notable variation in the market price on ships during the next few years. If one make the general statement that new motorships can be built in responsible foreign yards at a cost of about $75 per ton it will give some sort of indication of the price at which the Board's converted vessels can be expected to sell, taking into account that the ships will be about seven or eight years old when commissioned in their new form.

The converted ships, to be attractive to the operators, are required also to have more speed than they were built to attain under steam. The conversion should be accompanied, if possible, by an increase of two knots in speed. Even when the shaft horsepower is raised to 3,000 the increase will be only between three-quarters of a knot and one knot. The cost of the Diesel engine does not favor a greater increase in power in these existing vessels for the purpose of higher speeds, but it is deemed exceedingly desirable to get the slight extra speed accompanying the increase of engine power to 3,000, even though the cost of conversion is thereby augmented.

To meet this problem, after paring the estimates of the cost of the ship's auxiliaries and of the general shipyard work connected with the installation, the only course was to put the situation bluntly up to the engine builders and invite their co-operation to the respect to a reduction of engine prices.

It stands to the credit of the Diesel engine industry that it immediately recognized the seriousness of the obstacles confronting the Shipping Board and set itself willingly to work with the Government officials to achieve the only possible solution.

The Board recognized that the bids were not unreasonably high and turned their endeavors therefore towards the alleviation of the burden of some of the items. Specifications called for engines equipped with all piping and all attachments properly belonging thereon, thrust-bearing and shaft, injection-air flasks, starting-air tanks and an adequate supply of spare parts. Moreover a limit was placed upon the mean pressure in the cylinders for the purpose of ensuring a horsepower rating in accord with what is to-day generally considered as prudent practice for long runs. Furthermore, the tests required by the Shipping Board demanded not only an expensive testing equipment, but imposed also a considerable surcharge for labor and fuel. The most arduous part of the test was the 30-day trial of the first engine of each type, but all other engines were to be submitted to a 60-hour trial. These items all had their share in the enhancement of prices and the engine costs shown in the bids must, therefore, not be compared with the prices of bare engines given in ordinary quotations.

In its efforts to assist towards the reduction of engine prices the Board offered the loan of a 3,000 s.h.p. induction motor to the engine builders for testing purposes, the Board having some motors of that type available through non-installation of some steam-electric drives. They suggested also, for instance, the omission of the starting air tanks from the equipment to be furnished by the builders, these tanks having to carry a high freight rate by reason of their bulk and weight. In this and other ways a notable reduction was made from the original prices.

Having thus successfully overcome the obstacle that almost blocked the Board at the very start of its conversion program, the officials entrusted with the examination and consideration of the bids had to compile their recommendations for the awards, taking into account the various engineering and operating aspects. It is obvious that there would be little likelihood in such a case of giving satisfaction to all the bidders. Whenever contracts are to be let, whether for public or for private interests, success comes to one or more bidders, but very seldom to all. There must be disappointments. However, disappointments do not reflect upon the commercial or technical ability of the unsuccessful bidders. There are a multitude of reasons why some bids can be less favorable than others. So generally is this understood in business that there is no need to enter into them here.

Seven engine builders appeared in the final list of recommendations submitted to the Board by its technical staff. The machinery covered by their bids was representative of the types that compete to-day for the world's motorship orders.

How to apportion the awards amongst these was one of the most difficult tasks which the Board faced. There was, naturally, a guiding policy. The selection was not made haphazard. It would seem that the main considerations influencing the final selection were partly a complete recognition that the double-acting engine is entering upon its active era, and partly an acknowl-

edgement of an implied duty under the Act of encouraging the Diesel engine industry as broadly as possible.

One can develop from the bids tabulated last month that the average cost of the single-acting engines was around $290,000 or about $98. per s.h.p. (though it should be noted that the range was actually from $70 to $120 per s.h.p.). For this comparison the most favorable conditions are taken for the single-acting engines, namely, the price per engine on bids for four engines. Against this the double-acting engines of corresponding h.p. showed an average cost of about $230,000 or approximately $20 less per horsepower (this spread being reduced to $9, however, in the awards). This is very favorable to the double-acting type. An advantage accrues also to the double-acting engine when the weights of the two types are compared. The single-acting engine averaged about 1,000,000 lbs. according to the data submitted with the bids. A double-acting engine on the other hand, of substantially similar power, averages only 680,000 lbs. This saving of about 33% in engine weight means that a ship with a double-acting engine would have about 140 tons more d.w. and, therefore, increased earning capacity—which had to be taken into account over and above the capital saving. These figures, of course, relate entirely to the engines and ships covered by the Shipping Board's program.

The Shipping Board, therefore, felt justified in placing orders for double-acting engines with all the firms which had bid on that type of engine. It could not, however, shut its eyes to the fact that the double-acting engine has not yet proven itself equal to all the demands of marine service. On the other hand a number of prominent marine engine builders and shipowners abroad have shown their faith in the type to the extent of many million dollars in the aggregate and no matter what minor or major troubles may be experienced during the earlier period of its marine service, that type will consequently be developed to the full before long.

The decision of the Board therefore was that one double-acting engine should be ordered from Hooven, Owens, Rentschler; from McIntosh & Seymour and from New London, whilst two should be ordered from Worthington—the latter company being much further ahead commercially with its development.

Seemingly there was little to choose between the two-cycle and the four-cycle engine in the single-acting type. Apparently both types were about equal in respect to weight, space, economy of operation and reliability. This statement must not be too strictly construed, because it is evident that some of the four-cycle engines are longer than the two-cycle engines, but in a broad way the statement is about right. It should be interposed, however, that the double-acting engine shows about the same reduction in space as it does in weight and the cost of installation is consequently also somewhat reduced.

Awards for single-acting engines appear, therefore, to have been distributed largely with a view to the encouragement of those builders who were ready to go ahead with the construction of even bigger engines that will be required by the Board at a later date. The bulk of the program consists of the thirteen single-acting engines, and these were split among four engine builders—details appearing in the tabulated data.

The decisions of the Shipping Board show themselves to have been based upon a broad and well-considered policy. They take account of the past, of the present and of the future. They have been conceived in such a manner that the nucleus of the large motorship fleet which the Board will ultimately possess will be thoroughly up to date. These eighteen vessels operating under one flag will compose a more modern and efficient fleet than any other of its size under one house-flag. As the ships enter into service and demonstrate their economy of operation they will, undoubtedly, begin to pass to private ownership, because they can be sold to American buyers below the world's market price, an advantage which is substantially equivalent to a subsidy. This is a very important and far-reaching effect of "The Ship Conversion Act" which must always be kept in view.

As time proceeds, the Shipping Board, under the powers conferred upon it by "The Ship Conversion Act" must, of course, place further orders for the conversion of additional steamers and for the enlargement of its motorship fleet to the approximate number of fifty vessels contemplated by Congress at the time it passed the legislation. The program will, in the natural order of things, comprise larger units for which the Diesel engine industry will be better prepared by reason of the encouragement which the Board has given to the development of the double-acting engine. This impetus to the American Diesel engine industry is only the start.

Conversion Plans of the Shipping Board

Seventy-two 100-b.h.p. and 15-b.h.p. Oil Engines Shortly to be Ordered

Now that orders have been placed for the Diesel propelling engines for the first 18 ships, the task of preparing specifications for bids on the auxiliary machinery is under way. It is the intention of the Board, provided they consider prices on auxiliary Diesel engines, electrical generators and electrical deck machinery to be not unduly high, to tear out all the old steam machinery in the engine-rooms of the vessels to be converted as well as scrap the old steam deck machinery and steering gears. In other words, the vessels will be completely electrified, using auxiliary Diesel engines for driving generators.

The builders of the main engines will be given an opportunity to figure on the auxiliary units, as well as will other domestic manufacturers experienced in the construction of oil-engines for this purpose. Preliminary arrangements call for three auxiliary Diesels per ship of approximately 100 b.h.p. each direct-connected to a 75 k.w. generator, although this may be modified later in accordance with the requirements of the different ships. Also installed in the engine-room will be a small emergency oil-engine driven generator set of about 10 k.w.

Bids on converting the new hulls will not be asked of the shipyards for some months to come, there being no hurry because of the time to build the Diesel engines and the intervening period will give the Board opportunity to make well thought-out specifications.

The aggregate tonnage of the 18 vessels to be converted will be approximately 1,600,000 tons d.w. The speeds will range from 11 to 11.5 knots when fully loaded, or an improvement of at least 1 knot over the original steam plants, and it is possible that the maintained-average light and loaded speeds over a long period will be slightly in excess of the former maintained speeds, due to the consistent propeller revolution-speed brought about by the use of internal-combustion engines.

On the other hand, the engine speeds in most cases will be 95 r.p.m. instead of 90 r.p.m. as originally intended. This will necessitate, in nearly all ships, the installation of new bronze propellers. The latter will be especially designed for each individual ship in order that the most efficient results may be obtained.

As the Board has available propeller efficiency data of these ships when in service as steamers, it will be possible to design more effective propellers than at present fitted, even though there is a slightly higher revolution speed to contend with.

It is the opinion of the Shipping Board that when the program of approximately 50 of the Government's vessels are converted, the American Merchant Marine will be put in the forefront of the shipping world and will have the largest fleet of motorships under one control. As fast as the ships are converted they will take the place of the more expensively operated coal and oil burning steam-driven vessels, and will thus reduce to a great degree the cost of operating the entire Shipping Board fleet, and will increase the speed of delivery of American goods carried in American bottoms.

The latter statements have been issued officially from Washington and express the opinion of the Board. Yet they are but a repetition of the platform which MOTORSHIP has been consistently advocating since the armistice. It has taken the nation just six years to properly realize and to accept as a basic fact the claims which MOTORSHIP has put forward and proved over and over again during this period.

When converting the WALTER D. MUNSON of the Munson Line from a freighter to a passenger vessel, plans will call for installing two Diesel-electric generating-sets.

The Big Diesel-Driven Passenger Liner Has Arrived

Revised List of Large Motor-Liners Now Building

(Arranged in order of power)

Owners	*Tonnage*	*Power (indicated)*	*Name of Vessel*	*Hull Builder*	*Registry of Ship*	*Speed (knots)*	*Approx. Daily fuel-consumption*	*Type of Diesel Engine*	*Make of Diesel Engine*
Cosulich Line	20,000 g.	25,000 i.h.p.	Unnamed	Cantieri Cosulich	Italian	18½ knots	70 tons	4 cyc. d.a.	Triestino-B.&W.
Cosulich Line	20,000 g.	25,000 i.h.p.	Unnamed	Cantieri Cosulich	Italian	18½ knots	70 tons	4 cyc. d.a.	Triestino-B.&W.
Union Castle Line	20,000 g.	20,000 i.h.p.	CARNARVON CASTLE	Harland & Wolff	British	18 knots	65 tons	4 cyc. d.a.	Harland-B.&W.
Royal Mail Line	22,000 g.	16,300 i.h.p.	ASTURIAS	Harland & Wolff	British	16 knots	52 tons	4 cyc. d.a.	Harland-B.&W.
Royal Mail Line	22,000 g.	16,300 i.h.p.	ALCANTARA	Harland & Wolff	British	16 knots	52 tons	4 cyc. d.a.	Harland-B.&W.
Swedish American Line	23,500 dp.	16,300 i.h.p.	GRIPSHOLM	Armstrong-Whitworth	Swedish	18 knots	52 tons	4 cyc. d.a.	Burmeister&Wain
Union S.S. Co., of N. Z.	17,000 g.	16,000 i.h.p.	AORANGI	Fairfield S. B. Co.	British	17 knots	51 tons	2 cyc. s.a.	Fairfield-Sulzer
Netherland S.S. Co.	21,200 dp.	11,000 i.h.p.	P. C. HOOFT	Chantiers de La Loire	Dutch	15½ knots	35 tons	2 cyc. s.a.	Sulzer
*Hamburg S. Am. Line	14,200 g.	9,400 i.h.p.	MONTE SARMIENTO	Blohm & Voss	German	13 knots	30 tons	4 cyc. s.a.	B.&V.-M.A.N.
*Hamburg S. Am. Line	14,200 g.	9,400 i.h.p.	MONTE OLIVIA	Blohm & Voss	German	13 knots	30 tons	4 cyc. s.a.	B.&V.-M.A.N.
Houlder Line	9,500 g.	8,000 i.h.p.	Unnamed	Fairfield S. B. Co.	British	14½ knots	25 tons	2 cyc. s.a.	Fairfield-Sulzer
Elder Dempster Co.	9,200 g.	8,000 i.h.p.	Unnamed	Harland & Wolff	British	14½ knots	25 tons	4 cyc. d.a.	Harland-B.&W.
Elder Dempster Co.	9,200 g.	8,000 i.h.p.	Unnamed	Harland & Wolff	British	14½ knots	25 tons	4 cyc. d.a.	Harland-B.&W.
Brazilian Nat'l S.S. Co.	8,500 g.	7,800 i.h.p.	Unnamed	St. Nazaire S.B. Co.	Brazilian	15 knots	24 tons	2 cyc. s.a.	Sulzer
Rotterdam-Lloyd Line	16,000 dp.	7,000 i.h.p.	INDRAPOERA	De Schelde Co.	Dutch	15 knots	22 tons	2 cyc. s.a.	Schelde-Sulzer
†Not Given	12,000 g.	7,000 i.h.p.	Unnamed	John Brown & Co.	Not Given	13½ knots	22 tons	2 cyc. s.a.	Brown-Sulzer
*North German Lloyd	9,450 g.	6,500 i.h.p.	FULDA	Vulcan Works	German	13½ knots	21 tons	4 cyc. s.a.	Vulcan-M.A.N.
Messageries Maritimes	10,300 g.	5,400 i.h.p.	THEOPHILE GAUTIER	Chantiers de France	French	13 knots	17 tons	2 cyc. s.a.	Sulzer
‡Flensburg Steamship Co.	9,500 dp.	3,700 i.h.p.	RIO PANUCO	Fried. Krupp	German	13 knots	12 tons	4 cyc. s.a.	Krupp
Flensburg Steamship Co.	9,500 dp.	3,700 i.h.p.	RIO BRAVO	Fried. Krupp	German	13 knots	12 tons	4 cyc. s.a.	Krupp
TOTAL	297,250 tons	233,100 i.h.p.						*13 four-cycle* *7 two-cycle*	

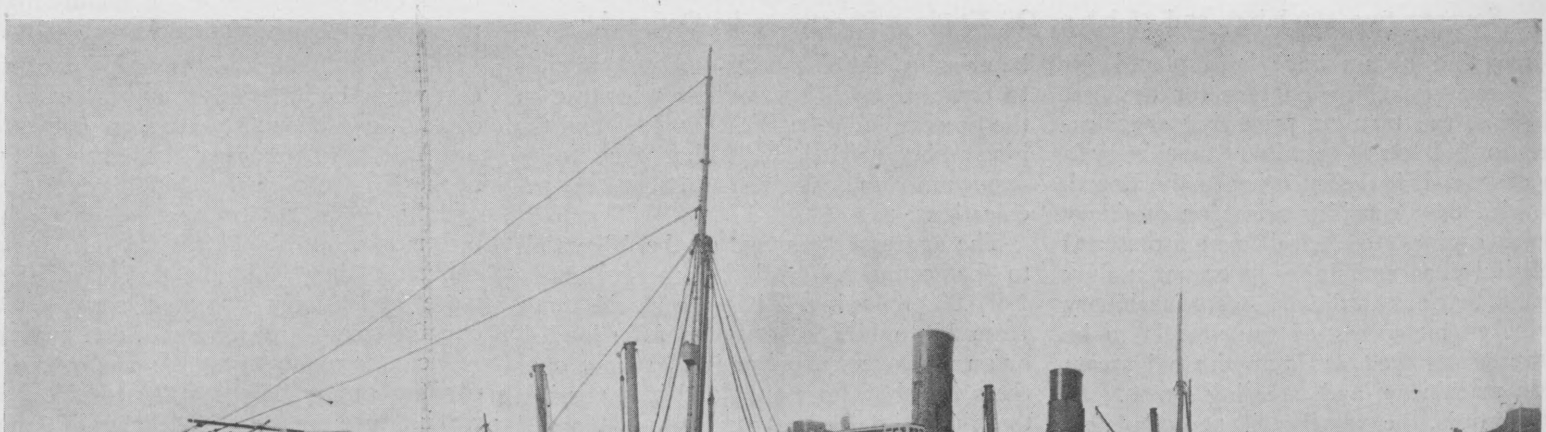
* Reduction-gear drive. † Accurate data not available. ‡ Recently put in service.

SOME months ago the United States Shipping Board announced that it would recommend Congress to authorize construction of two motor-liners of about 28,000 tons gross and 30,000 i.h.p.; but nothing has been heard of the proposal since the original announcement. It is to be hoped that the plan will not be abandoned but will be taken up vigorously when Congress convenes.

Meanwhile the number of passenger carrying motor-liners of big size now under construction in Europe is steadily increasing and has reached the remarkable total of 20 vessels aggregating 297,250 tons gross and 233,100 indicated horsepower.

When we previously published a table of liners building the largest and highest powered were the two boats building for the Royal Mail Line. The two new ships for the Cosulich Line, however, will be of the same tonnage but will be equipped with twin 10,000 shaft h.p. double-acting Diesel engines and will have a slightly higher speed.

It is interesting to note that 13 out of 20 ships have four-cycle Diesel engines installed, and the machinery is four-cycle in all cases where the power per engine exceeds 6,000 i.h.p.



"Aorangi," first of the great motor-liners at the fitting-out dock just prior to her trials. She is of 22,000 tons displacement, 17,000 tons gross and is propelled by four 3,475 s.h.p. single-acting two-cycle Sulzer Diesel engines

Converting a Liner to a Passenger Cruising Motorship

Parallel of a Case Recently Investigated by One of Our Shipowning Companies

By Ian Carnegie

EVERY year thousands of American citizens participate in extended cruises not only to various parts of Europe and the Mediterranean Sea, but to the West Indies, Canadian waters and other parts of the world. Generally British vessels are chartered for such routes due to their lower cost of operation. But there are several American liners available which, if converted to Diesel power, would form very economical vessels for this work.

An interesting demonstration of such a case came recently under the writer's consideration, and may prove of interest to shipowners and operators. It is safe to say that the reputations made by motorships have quieted all doubts as to mechanical reliability and the only remaining question is one of economics. This has been repeatedly demonstrated for cargo vessels, so a little investigation of the application of oil-engine drive to a purely passenger ship for cruising purposes may be sufficiently unusual to be of interest.

It may be stated at the outset that the actual figures given must be considered more as a parallel case to that actually worked out, yet the results and consideration are substantially of the same order and are equally reliable.

Type of vessel.

The vessel is pre-eminently a cruiser with dimensions 500' x 65' x 35', and of 11,000 gross tons. Twin-screw propellers of 8,000 total s.h.p. were designed to give the moderate maximum speed of about 17 knots. Such a vessel is dependent almost entirely on cruising for her revenue as she carries no cargo yet is not an express liner. Her accommodation, therefore, is for about 420 pasengers in two classes not widely segregated as to the standard of furnishings and including those refinements more usually found only on the largest transatlantic liners but necessary to make the vessel a comfortable home for the several weeks of each cruise.

Propelling Machinery.

In the particular case under review, the location of bulkheads, the size and shape of the engine and boiler spaces and the location of hatches, imposed limitations which would not pertain in an original design. This, and a very comprehensive electrical auxiliary equipment, are responsible for such a wide divergence in the capital outlay. The low head room calls for the employment of four single-acting high-speed 2,000 b.h.p. units paired off to drive the twin propellers by means of flexible intermediate shafts and single reduction gears. When cruising at speeds below 13 knots one engine of each pair may readily be disconnected from the gear. Units of this type and power have already demonstrated their reliability over thousands of miles of hard service.

There is no call for the special features of electric drive and no compensation for its high first cost, so no figures were obtained for this type of drive. Exhaust-gas boilers provide steam for culinary and heating purposes while at sea, and a small oil-fired boiler supplies this service while in port. To cater for the large electrical load three 350 b.h.p. Diesel auxiliaries are necessary. This gives one stand-by at all times and drives all deck and engine-room auxiliaries with the exception of one or two steam-driven emergency pumps and one air compressor for starting purposes.

The alternative-steam drive, which would be installed now—oil-fired Scotch boilers supplying superheated steam to single reduction-geared turbines, is contemplated in order that the comparison may be with the

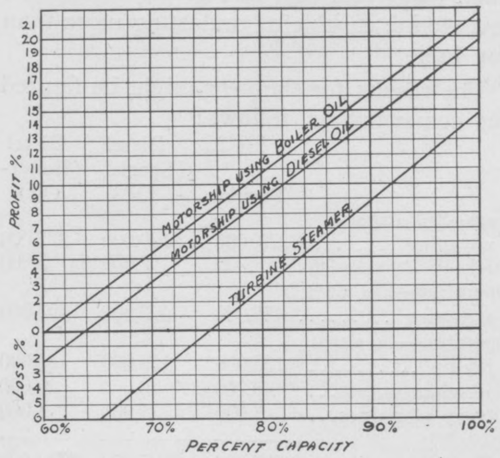


Diagram illustrating Mr. Carnegie's article

most economical of modern plants and not with out-of-date machinery. Remarkably low consumptions have been attained with such units, and the following figures are used as the basis of comparison:

Knots Speed	Tons of Fuel-Oil Turbine-Steamer	Per 24 Hours Motorship
17	90	40
16	78	33
15	67	27

Exception may be taken to these figures by some. It is our personal opinion that the turbine ship would have to be in the hands of an unusually competent engineer in order to maintain such a consumption, whereas the Diesel engine is less affected by the personal factor—as regards its fuel consumption—and that the actual fuel used would be considerably below this estimate; we prefer to err on the safe side. In port consumption, the Diesel-electric auxiliary equipment scores heavily over its rival. Allowance of 8 tons and 24 tons per day respectively, is made for this purpose, including the usual harbor movements.

Bunker capacity is, on certain routes, of great importance in operating costs. The turbine vessel allowed a capacity of 1,500 tons so we assume in both cases this fuel oil capacity, mostly in deep tanks as is now becoming more customary. The radius of action on one fueling, for example on a West Indian cruise from New York with a ratio of sea time to port time of about 1.40 would be as scheduled:

At 16 Knots Speed.

	Days at Sea	Days in Port	Days Total	Sea Miles
Turbine	16	11	27	6,150
Diesel	39	27	66	15,000

The value of this great radius of action is most readily apparent when one considers Mediterranean cruises or their equivalent. The turbine ship would be under the necessity of purchasing expensive fuel in Europe whereas the Diesel ship could cruise for two months on one fueling. If desirable, the gain in machinery space in the latter case could be utilized to provide additional bunker capacity; other uses for this gain in space seem to be more attractive, such as increased passenger accommodation. One other possibility suggested itself: the usual location of the swimming pool might be changed from the upper deck to the former forward boiler-room space or No. 2 hold with beneficial results on stability. A combination of these is adopted here, increasing the passenger capacity up to 440 for the motor-vessel.

Operating Expenses.

Without excessive detail analysis here, the following figures may be taken as representative of daily operating costs. This is based on total costs of $2,000,000 for the turbine vessel and $2,300,000 for the motorship; the hull not being new.

	Turbine	Diesel
Wages, deck dept.	$167	$167
Wages, Engine dept............	100	85
Wages, steward's dept...........	170	172
Deck and engine stores..........	200	210
Crew subsistence	112	108
Insurance	137	158
Depreciation and maintenance....	410	420
Overhead	500	500
	$1,796	$1,820

Of these items, the engine department crew is cut from about 25 to 18, though the higher scale of Diesel engineers' pay, now in vogue, offsets this reduction somewhat. This is a feature which time will cure, since supply and demand is the main regulating cause and there is no fundamental reason why the engineers on a Diesel ship should receive greater remuneration. We deal, however, with conditions as they are.

Stores are a somewhat larger item on the motorship, on account of the lubricating oil consumption. This factor has been repeatedly used by the turbine advocates to condemn Diesel drive. Admittedly the lubricating oil cost is very much higher, but it is still a small percentage of the operating cost and of the cost of the fuel saved. Different makes of Diesel engines vary much more widely in the matter of lubricating oil consumption than in fuel-oil con-

sumption, but given a good design and an engineer who knows his engine, there is no need for the use of lubricating oil ever to exceed one-third of a gallon per 1,000 b.h.p. hours, and figures of half of this, or less, are common. It may be added in passing that many engineers simply do not appreciate the possibility of cutting down oil use, and by flooding their engines with oil they only give themselves trouble with carbon, as every automobile owner knows.

The matter of fuel cost requires more than tabulation, and the cost worked out for one voyage will demonstrate the method of arriving at this figure.

Example of 45-day Mediterranean cruise fuel consumption:

28 days sea steaming, 17 days port, 10,800 miles:

	Turbine	Diesel
Sea fuel, tons	2,180	924
Port fuel, tons	408	136
Total	2,588	1,060

Assuming New York boiler oil at $12 per ton and European at $17 per ton and Diesel fuel at $19 per ton in New York the cost of Diesel fuel becomes $20,200; that of the boiler oil becomes:

1,500 tons @ $12	$18,000
1,088 tons @ $17	18,500
Debit arrival-margin of 250 tons at differential of $5 per ton	1,250
Total	$37,750

It may be noted that we know of several motorships successfully using ordinary boiler-oil for fuel, thereby obtaining greatly reduced fuel bills. Using boiler-oil the cost to the motorship for fuel is reduced to $12,730.

In West Indies cruising, the difference in favor of the Diesel is not quite so pronounced, being due, in the main, to the lower consumption; unless oil be taken on at one of the fueling ports in the Gulf with oil at less than New York cost, the same action will take place, when the motor-vessel will arrive home with sufficient bunkers remaining to undertake the subsequent—say European—voyage on cheaper oil than that already figured on. With the equivalent of three European, one South American, one West Indies cruise and one or two transatlantic straight passenger voyages in the tourist seasons, a schedule of 270 days voyaging and 95 lay-up days, might be arranged.

The depreciation and maintenance charge is of interest. The same percentage rate would doubtless be applied in each case for amortization of capital, but the higher charge against the motor-vessel is offset by lower maintenance. It is sufficient to note on this score that two heavy items, condenser retubing and boiler repairs, are completely eliminated. Replacement of worn parts of Diesel equipment is simple with standardized spares throughout, involving small delay and cost and giving virtually a new engine capable of outlasting more than one hull.

The results for the year might be figured out somewhat as follows:

	Turbine	Diesel (Special-Oil)	Diesel (Boiler-Oil)
Fuel—270 days voyaging	$220,,000	$120,000	$77,000
Fuel—95 days lay-up	15,000	7,000	5,000
Operating—270 days voyaging	485,000	492,000	492,000
Operating—95 days lay-up	133,000	133,000	133,000
Port charges, etc.	40,000	40,000	40,000
Lay-up pier dues	5,000	5,000	5,000
Total expenditure	$898,000	$797,000	$752,000

Net Passenger Revenue

Employment at	420 Total	440 Total
90% Capacity	$1,073,000	$1,126,000
80% Capacity	955,000	1,000,000
70% Capacity	835,000	875,000
60% Capacity	715,000	750,000

Turbine Steamer

Capacity		Year's Profit	Per Cent on Capital
90%		$175,000	8.75
80%		57,000	2.85
70%	*loss*	63,000	*loss* 3.15
60%	*loss*	183,000	*loss* 9.15

Motorship

	Year's Profit		Per Cent on Capital	
Capacity	Diesel-Oil	Boiler-Oil	Diesel-Oil	Boiler-Oil
90%	$329,000	$374,000	14.3	16.2
80%	203,000	248,000	8.83	10.8
70%	78,000	123,000	3.40	5.35
60%	*loss* 47,000	*loss* 2,000	*loss* 2.04	*loss* 0.009

Comments.

A simple graphical presentation of these results is given. The percentage capacity at which all profit ceases is of great interest; it is incidentally a very good demonstration why shipowners generally fight shy of this particular type of vessel with its non-express speed and lack of compensating cargo-capacity on which to "break even" in the event of failure of tourist and passenger trade. It also explains the low market value of a steam-driven vessel of this class.

It is rather remarkable that even in a low-speed vessel not in service on long runs where oil is especially dear, that such a marked superiority is attained. Under such circumstances, or with a higher speed, the fuel bill becomes a more dominating expense and consequently the motorship evinces still greater economies. The next step is to convert a vessel of this type.

Associated Oil Co. of San Francisco's latest coastwise motorship the "Port Costa," propelled by twin 400 s.h.p. Pacific-Werkspoor Diesel engines and recently placed in service

"Canvasless Sails" as Auxiliary to Oil Engines

Auxiliary Power Needed for Main Power and for Driving Motors

INTERNATIONAL interest has been aroused by the latest invention of Prof. Anton Flettner, whose name first came into prominence about two years ago, when he developed, in co-operation with German shipbuilders, the Flettner rudder, which has been adopted for a number of motorships and steamships. Owing to the story of his new rotorship invention having been taken up by the daily press, its uses and its construction have become garbled, with the result that it has been discredited to an extent in some practical circles.

On the other hand German shipowners seem to be taking its development very seriously, as the Hamburg-America Line is reported to have decided to use the system for ten new auxiliary Diesel-engined freighters of about 10,000 tons each, on their Hamburg-East Asiatic route, but we doubt the report's accuracy.

Professor Flettner has been connected with the Zeppelin enterprises, several patents of his having been produced in connection with aerial navigation. His idea in equipping a vessel with rotating towers in place of sails has been hailed as indicating a revival of the glories of the sailing ship, but Professor Flettner prefers to regard it rather as the ideal auxiliary of the motorship. That is to say, a vessel thus equipped would depend on her oil-engine power, but would double it or more on the voyage by use of the rotating power without increasing her crew.

The experimental vessel converted at Krupps is the Buckau, a 635 tons d.w. 455 tons gross ship, having general dimensions of 155½′ by 29½′ by 13½′, and equipped with a M.A.N. four-cycle, six-cylinder 160 b.h.p. oil-engine connected to the propeller through a clutch.

One of the most comprehensive descriptions of the new development we have yet read is that sent to us by one of our foreign correspondents, as follows:

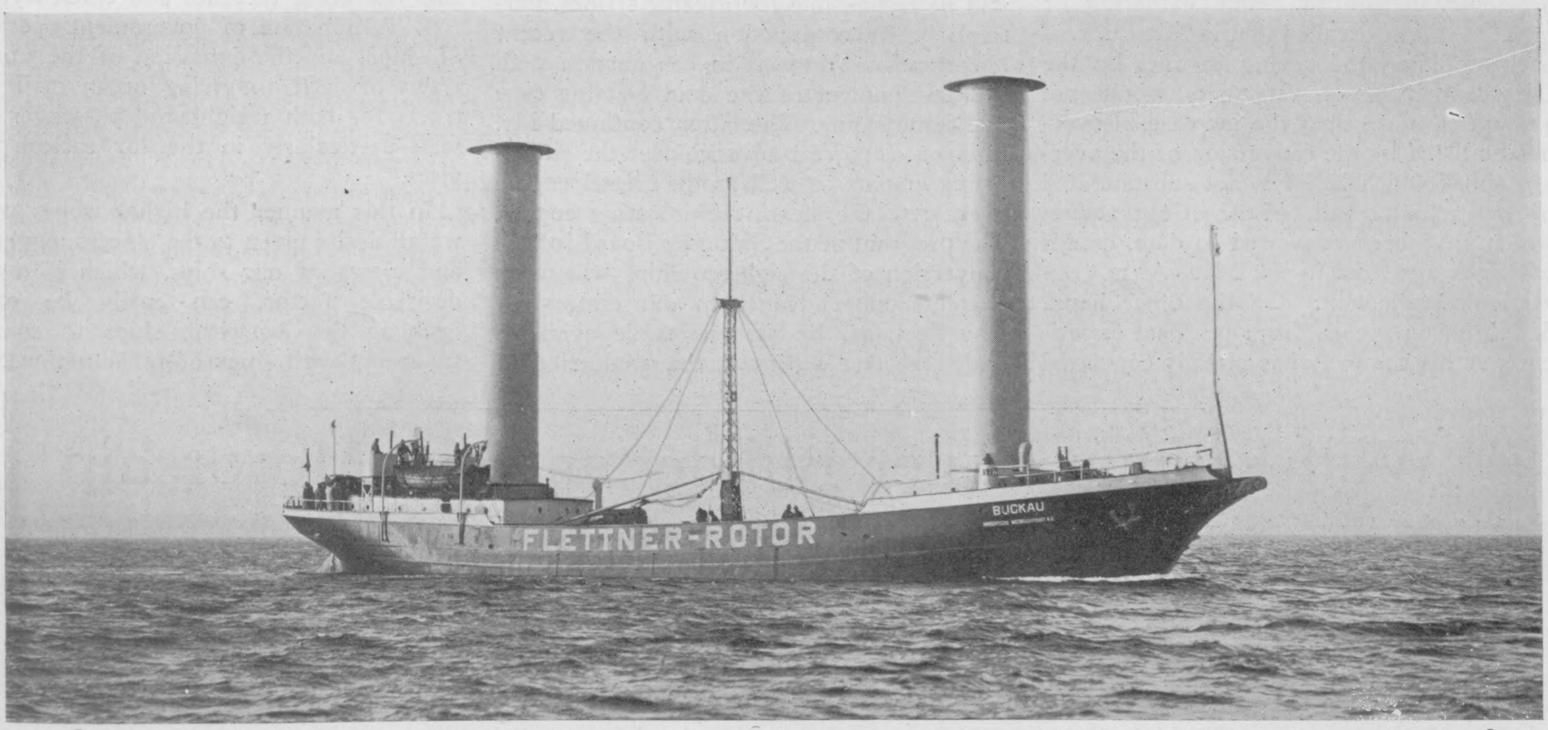
"The experiments commenced in France in 1910—which are still in somewhat casual progress—proved that the flat sail was a very inefficient method of utilizing the power of the wind, and by means of a rotary windmill the efficiency of this power was practically trebled. Professor Flettner, who is still on the right side of forty, is an expert on pressures of all sorts ,and it is not by any means unnatural that he can improve on this result. It would appear from the still somewhat incomplete reports of the trials that the engine was not working during the tests carried out in Kiel Bay. But the inventor himself refers to his system quite frankly as the ideal auxiliary to a motorship, and does not claim to supplant the internal-combustion engine or steam machinery.

The Buckau is fitted with two sixty-foot towers, ten feet in diameter, plated with 1½″ iron [this is probably a clerical error for 1/12″ iron.—Editor] and rotated at a speed of a hundred revolutions per minute by means of a nine horse-power electric motor at the base of each tower. It is quite understandable theoretically that when a ship is moving in a straight line with uniform velocity through the air, the vortex motion in the air immediately surrounding these towers produced by their rapid revolution will result in a force on the ship similar to that which has already been of the greatest use to aeroplane constructors, and is known as the Lanchester-Prandtl Vortex Theory of the lift of aeroplanes. Students of aero-dynamics all over the world have been using this theory in solving some of the most difficult problems met with in conjunction with aircraft—it must not be forgotten that Professor Flettner was formerly attached to Count Zeppelin—and it is equally useful in the very similar problems of the resistance of bodies in water and of screw propulsion. Brought down to golf or tennis, it is the use of the under-spin or top-spin.

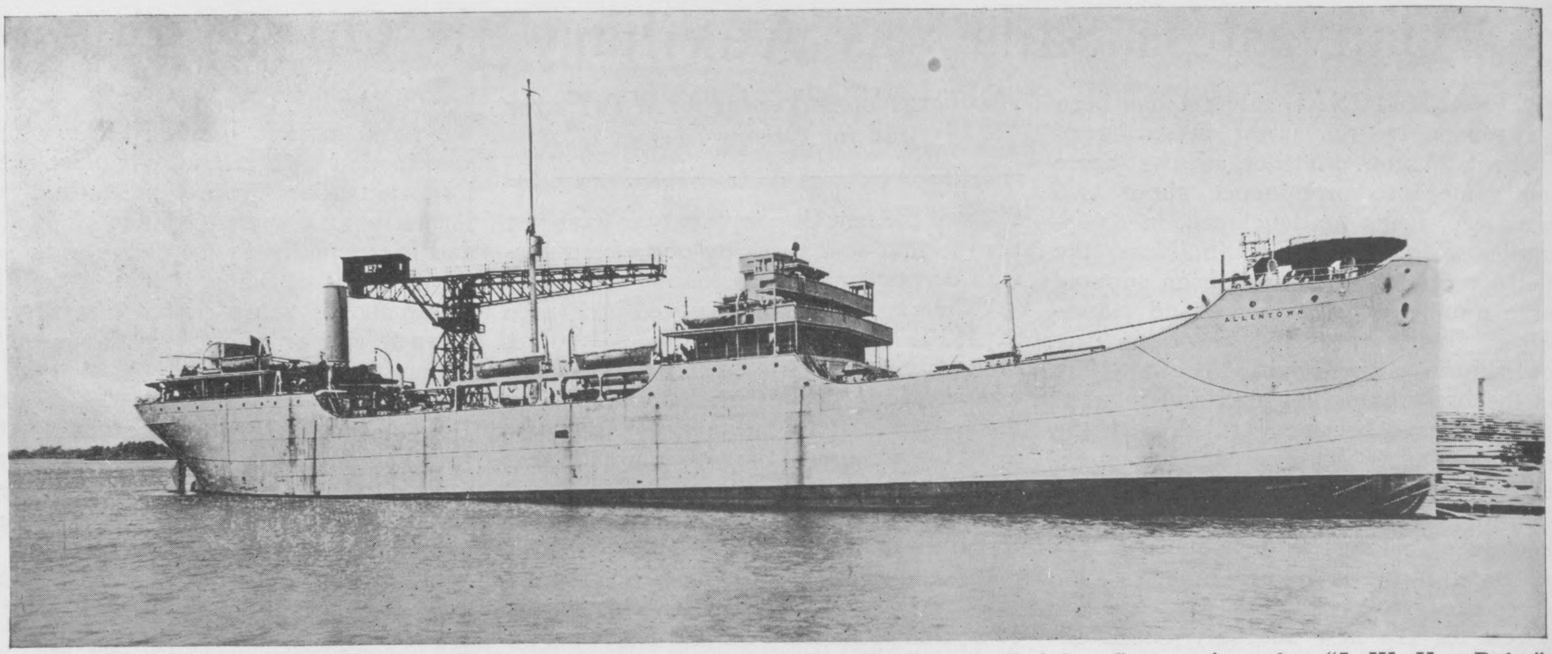
The revolving towers in the Flettner ship have therefore by combining their rotation and their translational motion a force acting on them at ninety degrees to the relative wind and also a force of resistance in the same direction as the wind on account of the rotation setting up the vortex motion required to produce the sideways force.

In theory the ideal result would be obtained by towers of infinite length, but of course this is quite impossible in practice and the desired result has to be obtained by a big flange on the top of the tower and the deck at the bottom. Without these flanges a great proportion of the vortex motion would be lost at the ends and the power obtained consequently reduced. As it is the value of the vortex motion depends on the rate of rotation of the towers and the roughness of their surface as it is generated by the friction between the air and the rotating substance.

The general result is that the force of a wind from, say—four points before the beam, is multiplied and utilized at an angle of ninety degrees, driving the ship ahead. In theory and in aeroplane practice it is satisfactory enough, and the small scale trials at Kiel would appear to support it, but it is quite likely that there would be difficulties in actual practice, one being the danger of rolling these huge towers out of the ship."



One of the most interesting maritime experiments of to-day—the application of rotating cylindrical "sails" as an auxiliary to ship propulsion



Now being converted to Ingersoll-Rand-Westinghouse Diesel-electric power the Atlantic Refining Company's tanker "J. W. Van Dyke," formerly the "Allentown," a Shipping Board steamer. Her stack is being removed.

Prominent American Shipowner and Conversion of Government Ships

Frank Munson in an Address Before the Propeller Club Declares the Government's Diesel Program to Be One of the Most Important and Striking Steps Taken in the History of the American Merchant Marine

WHEN one of our most experienced passenger cargo ship operators praises the government program of ship conversions as being one of the most important and most striking steps yet taken in the history of the American Merchant Marine and which will do more to bring about the maintenance of our flag on the high seas, it is time for other private shipping interests to awaken to the solution of the sea-going problems facing us today.

It was before a large gathering of shipping men at the Propeller Club on October 30th that Frank Munson, President of the Munson Line, made these statements which were in direct contrast to the belief of J. L. Luckenbach expressed two weeks previously before the same gathering of men. It will be recalled that in Mr. Luckenbach's opinion the saving in fuel by the Dieselization of our steamers would not amount to more than the increase in overhead created by the conversion of the average ships, which belief is not substantiated by the actual results of American vessels which have been converted to date, details of which appeared in the MOTORSHIP Conversion Supplement. On the other hand, Mr. Munson speaks from personal experience, as his company has already converted two vessels to Diesel oil-engine power.

Speaking of those who hold the view that America will not have a successful foreign-going merchant marine, due to the many disadvantages that it has to face in competition, Mr. Munson considers that such men are pessimistic and that American inventiveness and American genius will be responsible for greater strides, particularly in conjunction with the recent Dieselization Act and in conjunction with the development of the double-acting type of Diesel engine. The latter, continued Mr. Munson, is a great advance over the single-acting engine, as well as the Diesel engine itself over the steam reciprocating engine. The program of the Shipping Board for the conversion of the eighteen ships will mean a tremendous advance in our motorshipping fleet, as the millions made available under the Act will mean the production of the most advanced type of machinery, perhaps even higher development than the double-acting Diesel.

There are four things needed to make our Merchant Marine a success, said Mr. Munson.

1. Extension of our coastwise laws to the Philippine Islands, which will provide cargoes for many of our ships now laid up and which should be converted to Diesel drive to secure the most economical operation.
2. A Diesel program enabling American inventive genius being adapted in the making of greater strides with double-acting Diesel-engine design and production.
3. Perfection and increasing American ship operating facilities and efficiency.
4. Termination of government operation of ships, and the extension of the Coastal Laws of 1891 to giving ocean mail contracts for both freight and passenger vessels—particularly in the far eastern services.

In this manner the higher wages which we all desire given to the officers, engineers and crews of our ships, which is a very desirable factor, can easily be offset, enabling the American ships to compete favorably with ships of other nations.

Well-Known Boiler Builder and the Motorship

Retiring Address of Walter M. McFarland, President of the Society of Naval Architects and Marine Engineers

IN his address at the annual meeting of the Society of Naval Architects and Marine Engineers, New York, on November 13th, Walter M. McFarland, retiring president, covering recent progress of shipbuilding and marine engineering, referred to the conversion work now being carried out by the Shipping Board. Judging by the general tenor of his remarks he only reluctantly admits the benefits and economies which can thus be gained. Apparently he does not review the entire situation from the point of first-hand information from personal investigation. At the same time he mentions that in analyzing the subject of steamers versus motorships his study of the problem has not led him to expect the superseding of the steamer

by the motorship, although Mr. McFarland does not substantiate this belief with reasons or figures.

Touching upon the fuel question Mr. McFarland draws attention to the claim of Sir Charles Parsons, the steam-turbine expert, namely, that if all steam vessels were to shift from coal to oil there would not be enough fuel-oil available in the world for this purpose alone. At the same time he omits to draw attention to the fact that if all oil-burning steamers were converted to Diesel power the consumption of oil would drop to one-third of the amount now wasted under boilers.

Naturally, men whose business takes them along different lines arrive at different conclusions. Mr. McFarland, of course, is the manager of the well-known boiler building company of Babcock & Wilcox. One could hardly expect him to be a strong advocate of the "boilerless ship." The following is an extract from his address in question:

"Some encouragement is held out to our yards and other builders of internal-combustion motors in the program of the Shipping Board for converting certain of their vessels from steamers to motorships. Owing to the fact that the Government owns a very large number of vessels which are laid up and which, if allowed to remain in that condition, would ultimately have to be scrapped, it has been felt that something might be done by practically giving the hulls to shipowners who would agree to purchase and operate them if equipped as motorships. The first cost in this way is relatively low, so that the charges for interest, insurance and depreciation which count so heavily against a new motorship are reduced to a minimum. The figures which have been submitted to advocacy of this scheme, if correct, would indicate that these vessels can be operated so as to secure a profit.

"This arrangement amounts to a subsidy in favor of motor building, and, as I understand, the object of its authors and advocates is to provide examples of motorships, whose performance is expected to show such an economy as to lead to the gradual displacement of steamers by motorships. In analyzing the subject of steamers versus motorships my study of the problem has not led me to expect the superseding of the steamer by the motorship. There are undoubtedly services on which motorships of a certain power, and with present prices of oil, are attractive, but it seems to me that the problem is not so much a technical one as a broad financial one. The very high thermal economy of the internal-combustion engine with a consequent great reduction in fuel bill has a tendency to arouse enthusiasm which a careful study of all conditions does not entirely warrant.

"The vital point, it seems to me, is the question of the cost of fuel. All the authorities who discuss the subject of the available known sources of supply of oil warn us that it is very far from inexhaustible. Some indeed are so pessimistic as to talk of the exhaustion of oil within a comparatively short period, say two decades.

"The law of supply and demand, however, certainly makes it plain that, if steam motors were superseded by internal-combustion motors, the great demand for oil would make its price so high that the thermal economy of these motors would be much more than offset by the cost of fuel."

Sir James Kemnal, managing-director of the Babcock & Wilcox boiler company of England, in his address before the British Institute of Marine Engineers last month, stated that notwithstanding the low operating costs of marine Diesel engine installations, the newer types of steam-engine and boiler units could be operated at an equally attractive figure. Continuing, Sir James said: "As the class of oil which could be used under boilers was very much cheaper than that required for use in Diesel engines, there would probably be an actual saving in money in the use of turbines and boilers of high pressure compared with the Diesel engine."

With the oil-engine rapidly supplanting the marine steam plant, one cannot blame the boiler concerns for putting up a hard fight both in Great Britain and in the United States, whence the bulk of their business in the past has emanated. But it is a losing fight to struggle against the march of engineering progress and against a fundamental economy. It is better to follow the line of easiest resistance and advance with the times. History always repeats itself.

Problems of the "Seekonk" Conversion

A very comprehensive and most interesting paper on the above subject was read by J. C. Shaw at the annual meeting of the Society of Naval Architects & Marine Engineers held in New York. The paper was very well received, and a discussion took place afterwards. Mr. Shaw's paper dealt with every phase of the task and should be read by all shipowners. Owing to the conversion and subsequent operation of this ship having been very fully covered in the Motorship Conversion Supplement, we do not propose to reproduce Mr. Shaw's paper at this time. Copies of the paper, however, can be obtained from the Society at its office, 29 West 39th street, New York.

Operation of MS. "Cubore"

In his description of the five years' operation of the motorship CUBORE, Arthur B. Homer made public some important technical details concerning the various phases of Diesel engine work.

Built in 1920 at the Fore River plant of the Bethlehem Shipbuilding Company, she is now operated by the Ore Steamship Corporation of New York. The CUBORE has been under constant observation by the engineers who designed and built her engines. She is 468 ft. long, has a beam of 57 ft., and displaces 15,992 tons when loaded. Her engine is a six-cylinder, two-cycle machine rated to develop 2,400 s.h.p. on bore and stroke dimensions of 25½ inches x 48 inches at 100 r.p.m.

Extensive use of steel castings was made in the earlier forms of the design, piston heads, liners and crankshafts being originally made of this material. It was found, however, that the bore of a steel cylinder would not acquire that mirror-like finish which characterizes the wearing of a cast-iron cylinder and besides that the conclusion was reached that the wearing of the steel is accelerated by sulphur in the fuel oil.

Cast-steel piston heads showed excellent resistance to heat influences, but as it was difficult to get castings free from porous spots, the salt water used for cooling would eat its way through these porous places, even though the original hydrostatic test had shown the piston to be altogether tight.

For crankshafts and connecting rods, on the other hand, cast-steel as used by the Bethlehem Steel Corporation has shown itself to possess valuable properties. The forged crankshafts weighed 27 per cent more and cost 64 per cent more than the cast-steel ones, and the latter have given complete satisfaction to the engineers in charge of the CUBORE's engine.

It will be recalled that the CUBORE originally had steam auxiliary for deck and engine room service. She, therefore, afforded a good opportunity to get a direct comparison of the two systems, a summary of which is given below:

FUEL CONSUMPTION OF AUXILIARIES—M.S. CUBORE

	With Steam Auxiliaries	*With Electric Auxiliaries*
At Sea—Boiler	407 bbls.	
Aux. Diesel Generators	129 bbls.	147 bbls.
In Port—All Auxiliaries	121 bbls.	16 bbls.
Total	657 bbls.	163 bbls.
Saving		494 bbls.

In commenting on these results, Mr. Homer further states: "The boiler was a constant source of annoyance, steam having to be kept up at sea for stand-by purposes. Such large quantities of fuel oil were burned that the saving in maintenance has been considerable and the installation of all electric auxiliaries has effected an improvement all around."

Action of Diesel-Electric Hopper Dredges

"Hydraulic Seagoing Hopper Dredges" was the subject of an address delivered by Captain W. D. Styer, Corps of Engineers, U.S.A., before the thirty-second general meeting of the Society of Naval Architects and Marine Engineers. After giving an interesting review of the historical development of the power-driven hopper dredge, Captain Styer presented a detailed description of the four sister motor vessels of this type recently commissioned by the U. S. War Department, among them being the Diesel-electric driven A. MACKENZIE, fully reported in MOTORSHIP for July, 1924. Particularly noteworthy was his account of the action of the "drag." When the dredge reaches the bar which is to be removed, the pump

Pennsylvania Railroad's Diesel-electric driven tug "P. R. 16" illustrating the paper by F. L. Dubosque dealing with her tests against the direct-driven Diesel tug "Jumbo"

is started. As the drags are lowered with the pumps turning, the ship is made to travel over the bar at as slow a speed as is consistent with maintaining steerage way with the aid of twin screws. Proper speeds range from ½ to 2 knots over the bottom, which must often be increased in a strong current. Material is loosened from the bottom by the weight and motion of the drag, and by the suction, assisted where the bottom is clayey or unduly hard, by plows or scrapers attached to the drag. In some cases water jets are used to assist in loosening up the material; thereupon it is drawn up by the suction of the pumps and is discharged by them into the bins. The latter are provided with overflows slightly below the top of the coaming to carry off the water as the mud settles to the bottoms of the bins. It is apparent from the foregoing what demands are made on this type of dredge for maneuvering facility, a circumstance which undoubtedly had a good deal to do with the selection of the Diesel-electric drive.

Diesel Tug-Boat Tests Show Superiority Over Steam

The Diesel-Electric Tug "P. R. R. No. 16," the Diesel-Direct Drive Tug "Jumbo," and the Steam Tug "P. R. R. No. 10," Are the Subjects of Comparative Tests and Study by F. L. Dubosque, Mar. Supt. Penn. R R..

Significant conclusions concerning the equipment and operation of Diesel-propelled tugboats were presented by Frank L. Dubosque, of the Pennsylvania Rail Road Company, in a paper on the Diesel-electric tug P. R. R. No. 16 read before the thirty-second general meeting of the Society of Naval Architects and Marine Engineers. In a series of extensive and carefully conducted trials a mass of comparative data on this craft, on a steam-propelled sister vessel—the P. R. R. No. 10, and the Cornell Towboat Co.'s Diesel-direct drive tug JUMBO were accumulated.

The P. R. R. No. 16, it will be recalled, is fitted with twin Winton Diesel engines of 375 s.h.p. each coupled to Westinghouse main generators and exciters furnishing current to a single propeller-shaft motor of 575 s.h.p. P. R. R. No. 10 has a standard Pennsylvania Railroad compound condensing steam engine of around 1,000 i.h.p. As the power plant of the JUMBO, a 600-s.h.p. Nelseco Diesel engine, manufactured by the New London Ship and Engine Company, is installed. It is direct reversible and direct coupled.

Since the hulls of the steam tug and of the Diesel-electric towboat are of steel and duplicates, the comparison between these two as given by Mr. Dubosque will be regarded by many as conclusive. The JUMBO, however, although displacing nearly the same tonnage as the Diesel-electric boat, is of wood and four feet shorter and her hull is, therefore, presumably less fine and offers greater resistance. In fact, the beam of the wooden boat is one foot greater than that of the other two. The competition would probably have been fairer if identical hulls had been selected both for the Diesel-electric and for the Diesel-direct drive and it is not unlikely, therefore, that engi-

This direct-driven Diesel tug ran a series of comparative tests against the Diesel-electric driven tug illustrated above. The "Jumbo" is owned by the Cornell Tow Boat Company

neering opinion will differ as to the conclusiveness of the comparative test.

Two things, at any rate, are certain. The difference between the two Diesel tugs appears to be less than that which may have been anticipated by the proponents of both systems and both of them showed an economy with which the steam tug could not compete. Since the hulls of the steam towboat and of the Diesel-electric tug were identical, there also appears to be little reason for questioning the validity of the latter comparison.

P.R.R. No. 10

Weight of Main Engines, Shafting and Propeller	30 tons
Weight of Scotch Boiler, Stack, Pumps, Piping and Valves	72 tons
Weight of Coal, Water, including bunkers and tanks, 3½ days' supply	75 tons
Total	177 tons

P.R.R. No. 16

Weight of main engines and attached auxiliaries, air bottles, muffler, shafting, propeller, stack	79 tons
Weight of Electric Generators, motor, switchboard and wiring	47 tons
Weight of fuel and lubricating oils, including tanks for 7 days' supply	32 tons
Increased weight of foundation	7 tons
Total	165 tons

Data on Jumbo not available.

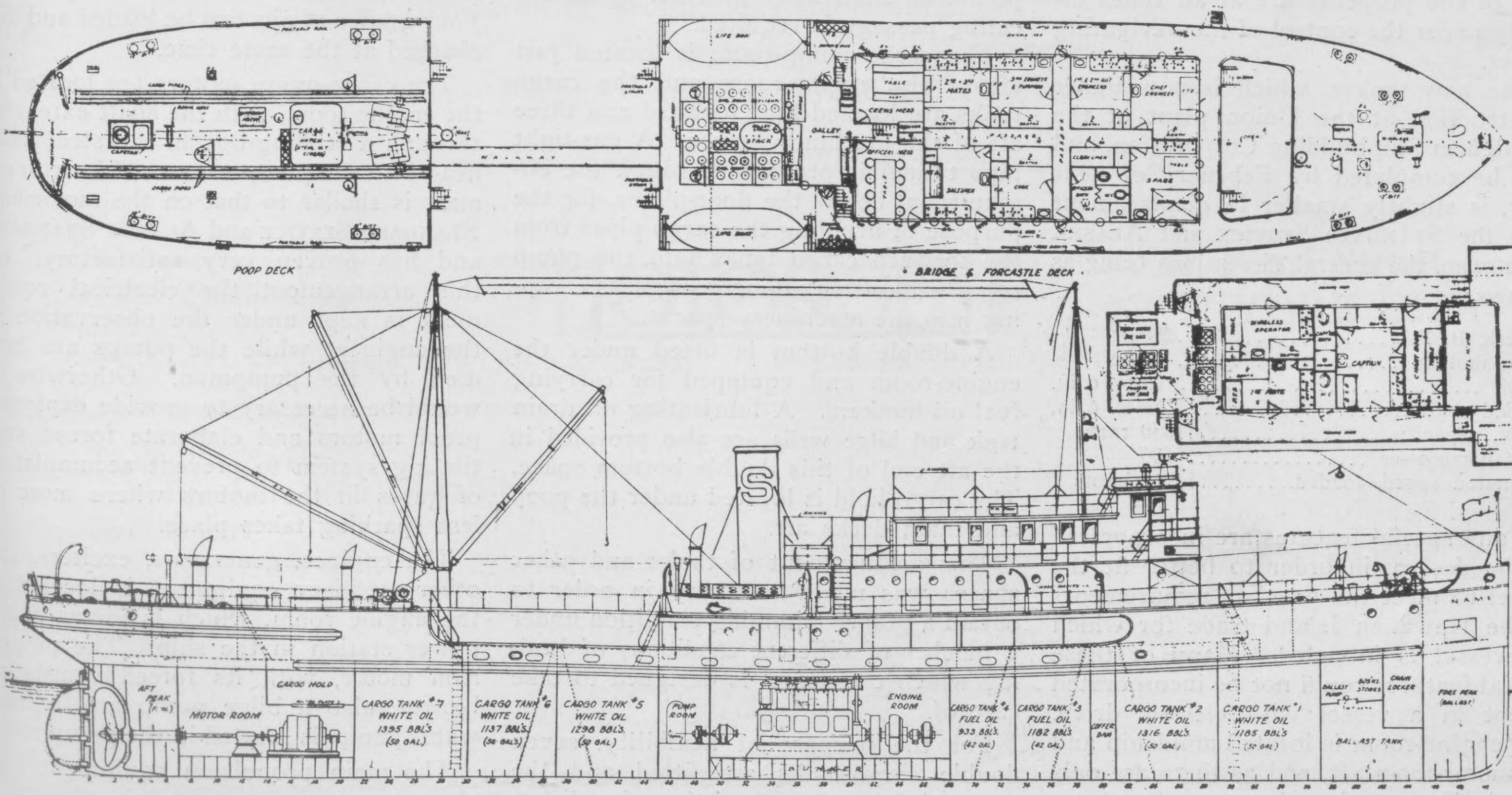
	Jumbo (*Direct Diesel Drive*)	P.R.R. No. 10 (*Steam drive*)	P.R.R. No. 16 (*Diesel-electric drive*)
Hull			
Material	Wood	Steel	Steel
Length	101′ 0″	105′ 0″	105′ 0″
Beam	25′ 0″	24′ 0″	24′ 0″
Draft	12′ 0″	12′ 5″	12′ 6″
Displacement	350 tons	337 tons	347 tons
Engines			
Cyl. Dia.	16½″	18″ & 36″	13¼″
Stroke	24″	26″	18″
Propeller			
Diameter	7′ 6″	9′ 0″	9′ 6″
Pitch	5′ 9″	12′ 3″	9′ 4″
Material	Bronze	Cast Steel	Cast Iron
Results			
Speed Light	12.28 Stat. Mi.	13.60 Stat. Mi.	13.52 Stat. Mi.
Propeller Speed	202 r.p.m.	118 r.p.m.	133 r.p.m.
Total Power	643 i.h.p.	715 i.h.p.	1,175 i.h.p.
Speed Towing	5.95 Stat. Mi.	6.34 Stat. Mi.	6.36 Stat. Mi
Tow-Line Pull	13,160 lbs.	15,100 lbs.	15,180 lbs.
Total Power	823 i.h.p.	698	1,163
Propeller Speed	201 r.p.m.	101.4 r.p.m.	117 r.p.m

Mr. Dubosque further stated that the Diesel-electric tug is operated with one man less than the steam tug and the P. R. R. No. 16 uses only 214 gallons of fuel oil in 8 hours at a cost of 5 cents per gallon, or $10.70 total. Lubricating oil costs bring this total up to $12.96. For the steam-driven tug P. R. R. No. 10, 3.58 tons of bituminous coal are required for the eight hours at a total cost of $23.37. Here is an operating cost difference of practically two to one in favor of the Diesel, a fact which towboat owners and operators should notice carefully.

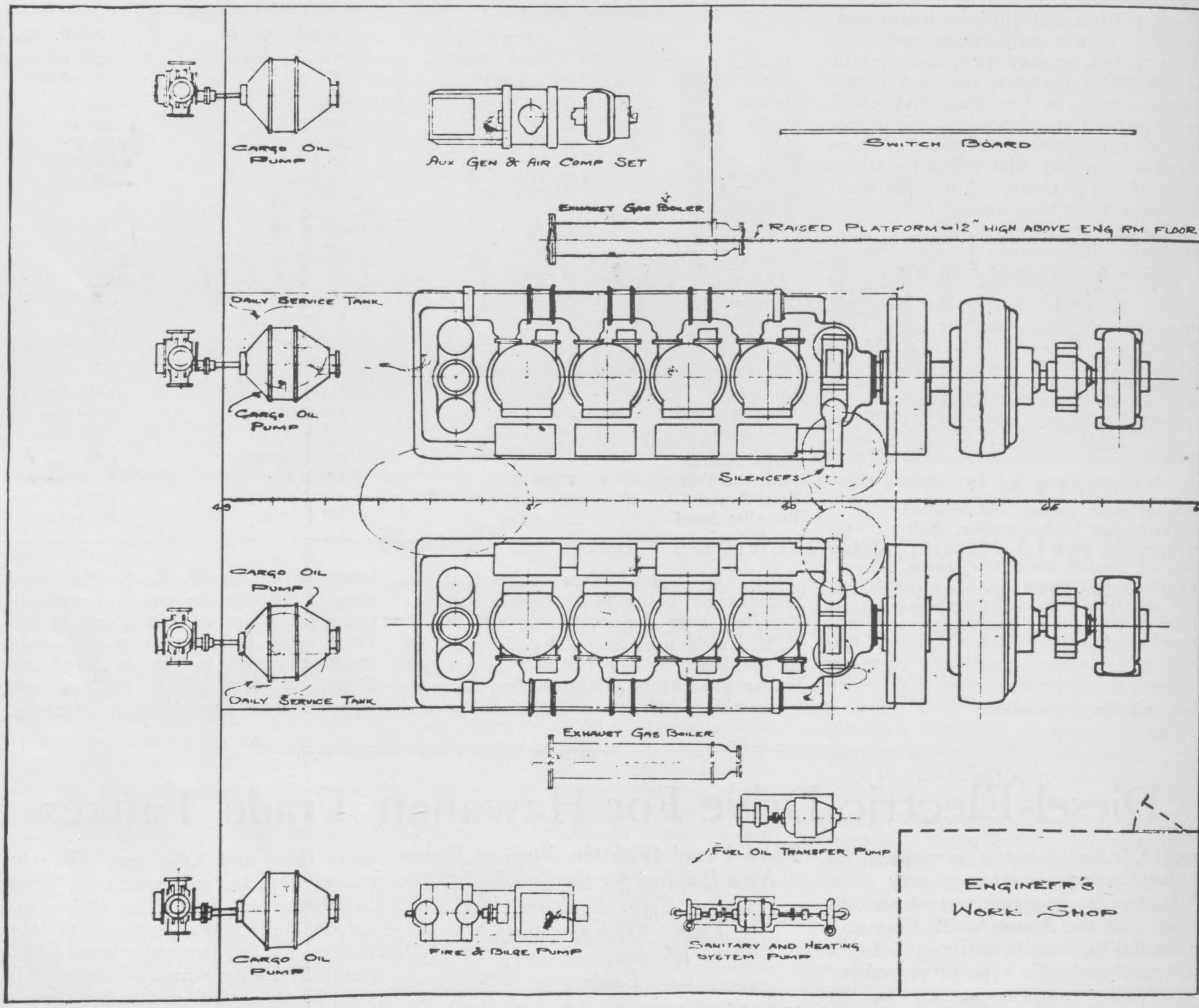
Diesel-Electric Drive For Hawaiian Trade Tanker

Third Vessel With this Type of Power Now Building for the Standard Oil Co. of Calif. Equipped With Twin 400-h.p. Pacific-Werkspoor Diesel Engines

THAT Diesel-electric propulsion for tank vessels is proving very satisfactory in operation is evidenced by the fact that the Standard Oil Company (California) has again contracted for a tank vessel with this type of propulsive power. This company already has in operation two Diesel-electric tankers, the Standard Service and Alaska Standard, both of which have been in operation for some time, and have very successfully navigated in the coastwise trade between San Diego and Seattle, as well as in the narrow and intricate passages of Alaskan waters. In this particular service the extreme flexibility which is obtained from pilot house control as fitted in these vessels has proven a great advantage, as both the speed and the direction of rota-



Inboard profile and accommodation plans of Diesel-electric tanker for the Standard Oil of California's Hawaiian trade



Engine-room plan of Diesel-electric driven Standard Oil tanker

tion of the propeller are at all times directly under the control of the navigating officer.

The new tanker, which is now under construction at the Union plant of the Bethlehem Shipbuilding Corporation, and will be completed by February of next year, is slightly smaller in displacement than the Standard Service and Alaska Standard, the general dimensions being as follows:

Length, B. P.	210 ft.
Beam molded	36 ft.
Depth	16 ft. 6 in.
Loaded draft	13 ft. 6 in.
D. W. capacity	1350 tons
Shaft horsepower	600
Estimated speed, loaded	9¾ knots

Many special features are incorporated in the design, in order to better fit the vessel to meet the peculiar requirements of the Hawaiian Island trade for which the vessel is intended. Many of these special features could not be incorporated except in a vessel with electric drive. The engine-room is located amidship and the motor-room aft, and as there are only electrical connections between these two points no shaft alley or other communicating passage is required.

The cargo pump-room is located just aft of the engine-room and the cargo tanks are located four forward and three aft of the machinery space. A gas-tight pipe tunnel is provided through the engine room below the floor-plates, for the purpose of bringing the cargo pipes from the forward cargo tanks into the pump room without any danger of gases escaping into the machinery spaces.

A double bottom is fitted under the engine-room and equipped for carrying fuel oil bunkers. A lubricating oil drain tank and bilge wells are also provided in the aft end of this double bottom space. The cargo hold is located under the poop and main decks aft.

This arrangement of tanks and other spaces was made necessary in order to obtain a proper trimming condition under a number of different conditions of loading which the vessel is designed to take care of.

For the purpose of flexibility, seven double cargo-tanks are fitted and the cargo piping so arranged that nine different combinations of cargo are possible. Four grades of oils can be loaded and discharged at the same time.

The cargo-pump motors are located in the engine room, with the shaft extension through a stuffing-box in the steel bulkhead into the pump room. This arrangement is similar to that on the motorships Standard Service and Alaska Standard, and has proven very satisfactory. By this arrangement the electrical equipment is kept under the observation of the engineer while the pumps are handled by the pumpman. Otherwise it would be necessary to provide explosion proof motors and elaborate forced ventilating system to prevent accumulation of gases in the motors where more or less sparking takes place.

The engines, generators, exciters, and other auxiliary equipment is located in the engine room, which is virtually the power station in the ship. The propulsion motor, with its forced ventilating blower, also a bilge pump and a fresh water pump, is located in the pump room.

The main propulsion equipment con-

(*Continued on page* 893)

MOTORSHIP
CONVERSION
SUPPLEMENT

THE CONVERSION SUPPLEMENT is now ready for distribution. Devoted exclusively to the problems arising out of the Ship Conversion Bill, this Supplement contains 128 pages and cover, splendidly illustrated and printed.

Never before have we compiled such a mass of information of incalculable value to American Shipowners as that which is inserted in this Ship Conversion Supplement.

In addition to a verbatim copy of the Sales Contract, all ships available for conversion are listed, their plans and brief specifications, their present location, etc., notated.

A series of articles describing in intimate detail the results accomplished by Shipping Board vessels which have already been converted, their records, operating economies over previous steam experience, etc.

A series of articles on such subjects as Electrifying Deck Auxiliaries, etc., form another section.

These are but some of the features which make this Supplement indispensable to every shipowner, shipbuilder and naval architect.

The edition is limited. May we suggest you promptly mail us your order for whatever number of copies you desire.

Price Per Copy, One Dollar

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(*Continued from page* 890)

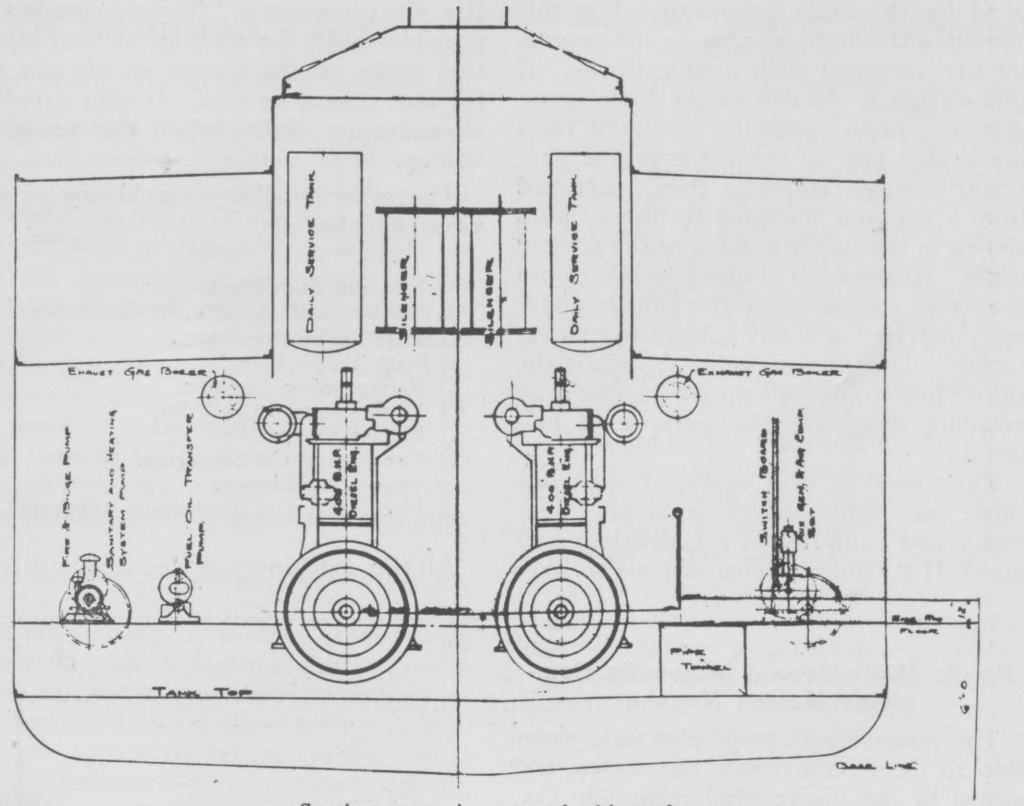
sists of two four-cylinder, 400 h.p., 225 r.p.m. Werkspoor-type Diesel engines built by the Pacific Diesel Engine Company, Oakland.

These engines will be direct connected to two 245 K.W. 230-Volt main generators, and two 30 K.W. 115-Volt exciters, manufactured by the General Electric Company. This equipment furnishes power for the 600 H.P. 460-Volt G2. propulsion motor, which operates at 130 r.p.m.

The Diesel engines are fitted with attached pumps for circulating water, bilge water, and lubricating oil. A plunger-type bilge pump driven from the propeller shaft is also fitted in the motor-room. The seatings under the propulsion motor are made water-tight up to the propeller shaft, which makes it possible to run the propulsion motor even if the motor room should accidentally become flooded. The exhaust gases from the engines are also utilized for obtaining hot water both for heating of the living quarters and for showers and other purposes.

The propulsion equipment is controlled by a Ward-Leonard system, and the general arrangement of connections is indicated in the simplified wiring diagram shown. With this system, the speed regulation and reversal of the propeller is accomplished by varying or reversing the field current of the main generators.

The Diesel engine run at constant speed and in the same direction at all times, as long as the vessel is in operation, and the load on the engines is entirely taken care of by the governing equipment. The engines are designed to regulate within a speed variation of four per cent with a load change from full-load to no-load or from full-ahead to full-astern in three to five seconds, which is about the time it takes the navigating officer to move the control handle. That this condition is actually accomplished has been proven in the operation of the present Diesel-electric vessels of the Standard Oil Company, and the engines will take care of these severe conditions so well, that not even a flicker of the lights can be discerned. The value of such flexibility will no doubt be fully realized.



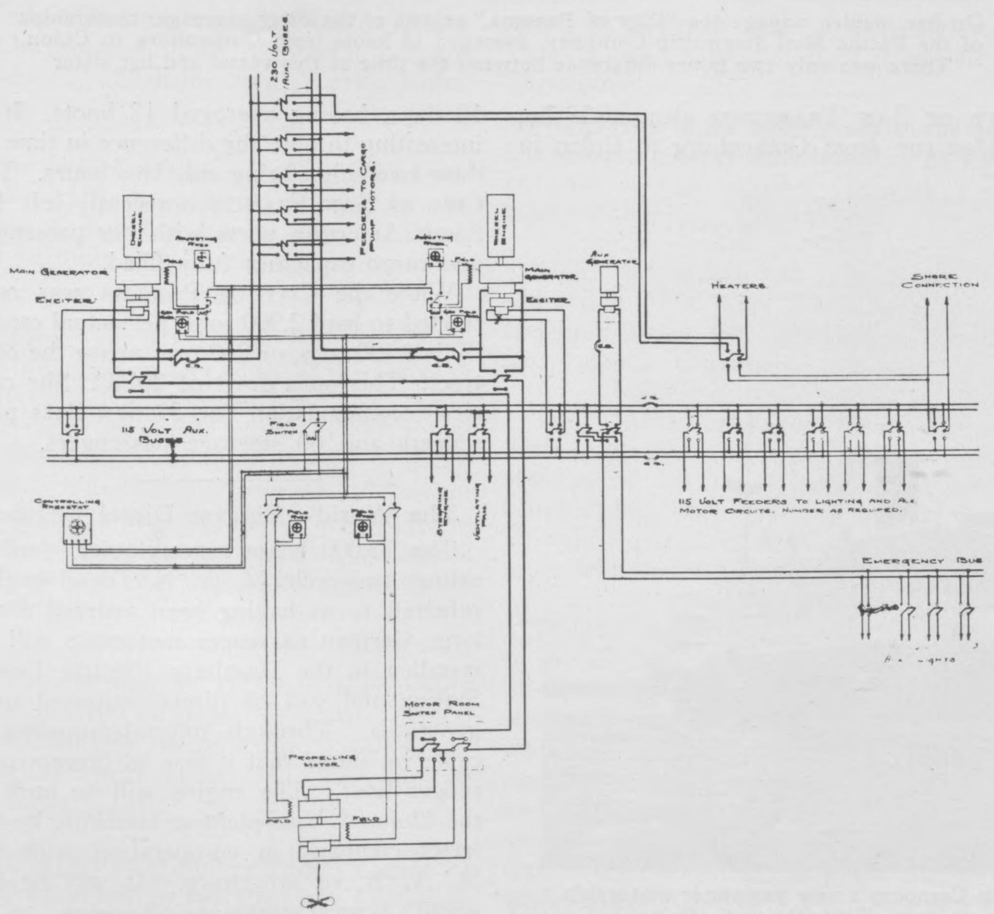
Section at engine-room looking aft

A ventilating duct in the center of the unit is connected to the discharge of the ventilating blower, which is located in the upper motor-room, taking air from the steering engine space and discharging it to the propulsion unit as shown. The air passing through the armature and over the commutators at each end also provides a very efficient means for ventilating the motor room. Temperature relays are provided in the bearings of the motor, which will warn the engineer in the engine room should the motor bearings, which are flood lubricated, for any reason heat up.

Actual experience has shown that it is possible to vary the propeller speed from 1 to 130 r.p.m. within the period of seven seconds. It is also possible to keep running indefinitely at any speed from one revolution per minute up. This controller is directly geared to a control stand in the pilot house, and the propeller speed is at every moment in full proportion to the position of this control lever.

If anything happens that should make it necessary for the engineer to cut out one of the engines, a generator, or one-half of the motor, he only has to open a small switch at the top, which "kills" the entire propulsion unit. After this is done any unit is cut out by throwing any of the four large switches into the lower position and then again closing the top switch. This again puts the equipment directly under the control of the captain with the one unit cut out, whether this be a motor armature or a generator. This whole operation is accomplished in only a few seconds.

As indicated in the wiring diagram, it will be seen that all auxiliary equipment except the four main cargo pumps, is 115-Volt, and supplied with power by the two 30 K.W. exciters. The cargo pumps, however, are 230-Volt, and sup-



Wiring diagram of electrical machinery of Standard Oil tanker

plied by the main generator. For this condition the field switches on the generator are arranged with double throw. If this switch is thrown in the lower position, the main controller operated from the bridge has no control over the generator voltage, which is then controlled from a rheostat operated by the handles shown in the upper portion of the control panel. However, it is also possible to use the cargo pumps when the ship is under way, provided it is not subject to maneuvering. Thus it is possible to ballast the ship while going full speed, in this way avoiding delay for the purpose of ballasting.

The vessel is also equipped with one small gas-engine-driven auxiliary generator and compressor, set, consisting of one 7 H.P. Union engine and a two-stage Rix air compressor. This set makes it possible to fill the starting air and injection tanks on the engine should the air for any reason be lost. It also supplies all necessary lights when the vessel is laid up.

The other auxiliary machinery of the vessel consists of:

1 Fire and Bilge Pump
1 Sanitary and Heating Service Pump.
1 Fuel-Oil Service Pump.
1 Fresh Water Pump.
1 Refrigerating Machine.
1 Motor-Room Bilge Pump
1 Ballast Pump.
1 Lubricating Oil Separator.
3 Ventilating Blowers
1 Fire Foam Fire Protection Apparatus.

All this machinery is electrically-driven and fitted with magnetic control units.

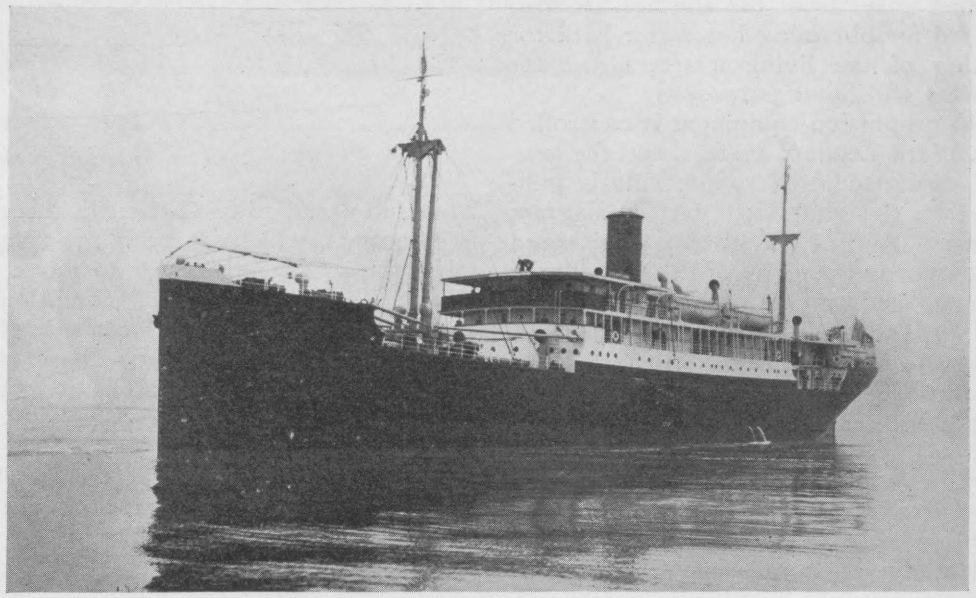
The four cargo pumps are 230-Volt, and are operated by drum controllers located in the engine room, with operating handles through the bulkhead into the pump room, and equipped for 33 per cent speed reduction by field control. The cargo pumps are of the rotary type, made by the Northern Pump Company, and are designed to handle 350 G.P.M. at 100 pounds discharge pressure.

The steering engine is of the electric hydraulic type, manufactured by the Hyde Windlass Company, and operated by a Bethlehem hydraulic telemotor and fitted with electric helm indicator. There is also fitted one windlass, two cargo winches, and one capstan, all motor-driven, manufactured by Allan Cunningham Company.

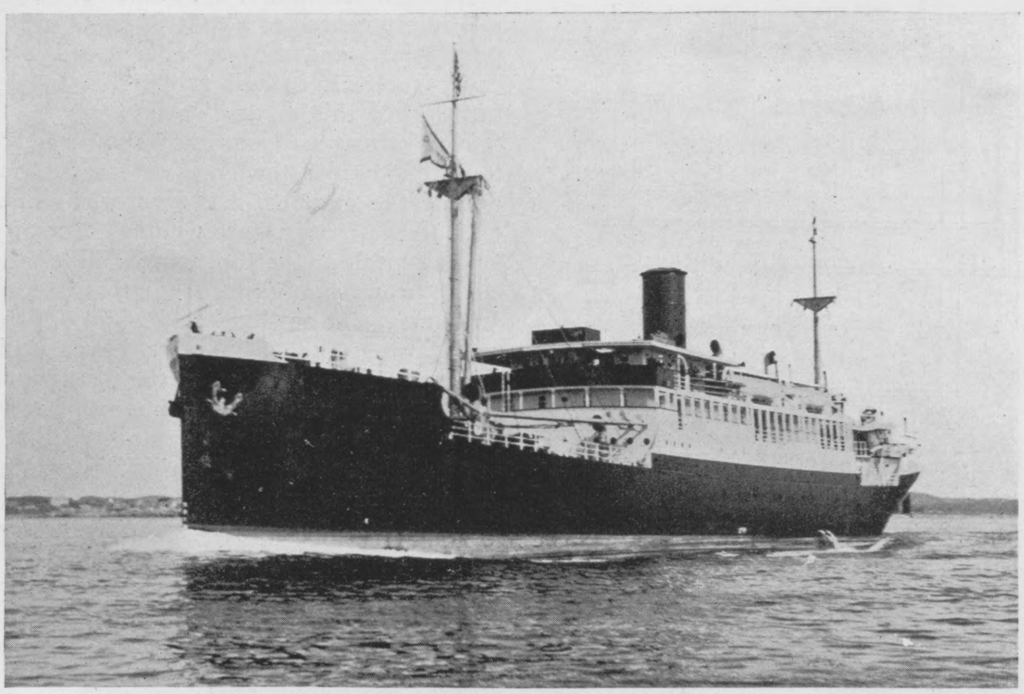
Pacific Mail's Second Motorship Completes Maiden Voyage

The motorship CITY OF PANAMA, sister ship to the CITY OF SAN FRANCISCO, and owned by the Pacific Mail Steamship Co., San Francisco, ran her trials from the Götaverken Shipyard, Gothenburg, Sweden, on October 4th. Although her contract speed was 12 knots, it was shown that she could make 13.3 knots when on the trials with her twin Götaverken-B. & W. Diesel engines developing 3,100 i.h.p., as against 2,600 i.h.p. normal power. Furthermore, the fuel consumption was only 9 tons per day instead of 9½ tons as stipulated. Also, the vessel made a complete turn-around in half the time stipulated. The engine speed at 2,600 i.h.p. is 130 r.p.m.

On October 8th, the CITY OF PANAMA left Gothenburg for San Francisco via the Panama Canal. Aboard as a passenger was Hugo Hammar, Managing-Director of the Götaverken shipyard. The vessel arrived at Colon on October 26th, having made the passage in 18 days. The sister motorship CITY OF SAN FRANCISCO also made her maiden run from Gothenburg to Colon in 18 days, having averaged 12 knots. It is interesting to note the difference in time of these two ships, being only two hours. The CITY OF SAN FRANCISCO recently left for South American ports with her passenger and cargo capacities fully filled.



On her maiden voyage the "City of Panama," second of the sister passenger motorships of the Pacific Mail Steamship Company, averaged 12 knots from Gothenburg to Colon. There was only two hours difference between the time of this vessel and her sister



On her maiden voyage the Pacific Mail Steamship Company's new passenger motorship "City of San Francisco" averaged 12 knots from Gotherburg to Colon

While the CITY OF PANAMA was contracted to load 2,900 tons, her actual capacity is 3,150 tons, or 250 tons above the contract. This on a draft of 20′ 3″. She carries accommodation for 59 first-class passengers and 60 steerage passengers.

The World's Biggest Diesel Engine

The 15,000 b.h.p. nine-cylinder, double-acting, two-cycle M. A. N. Diesel engine referred to as having been ordered for a large German passenger motorship will be installed in the Hamburg Electric Power Station and will be direct-connected to a generator. Through misunderstanding a cable we stated that it was to drive a passenger liner. The engine will be built at the Blohm & Voss plant at Hamburg by the latter company in co-operation with the M. A. N. of Augsburg. It will be the world's biggest stationary oil engine.

Four More Motorships for Isthmian Line

Two Vessels for the Great Lakes and Two for World Trade Under Consideration

Active consideration is being given by the Isthmian Steamship Lines to the project of making substantial additions to their motorship fleet. It will be recalled that this is the company which operates the motorships STEELMOTOR and STEELVENDOR on the Great Lakes, besides maintaining a large fleet of steamships which are in general service throughout the world.

So well has this firm been satisfied with the results gained by them in the operation of the two motorships mentioned above that they have announced their intention of proceeding immediately with the study of designs of other vessels similarly propelled.

An important official of the company stated that there is little likelihood of their adding any more steamships to their fleet.

Both the hulls and Diesel engines for the contemplated motorships are to be built in America and, according to our informant, foreign yards and shops are not being considered.

Four vessels are contemplated, two smaller and two larger ones. The former will probably have a length around 275 feet, will be between 1,800 and 2,000 tons gross register and will be propelled with a single engine of about 1,000 s.h.p. Like the STEELMOTOR and the STEELVENDOR, they will be operated on the Great Lakes for the transportation of steel products.

We were informed at the offices of the Isthmian Steamship Lines that during the year and a half that the above vessels have been in commission neither of them has ever had a moment's delay on account of machinery, in spite of the fact that they operate on 20 to 24-hour turn-arounds.

In the operation of their steam vessels the Isthmian Lines employ the most up-to-date devices for recording CO_2 in the boiler uptakes, draft pressure, steam pressure, and make an all-around scientific job of it. As the result of these methods they claim to have reduced their operating expenses 25 per cent below the average for similar vessels operated without any special scientific technique.

All the more significant, therefore, is the fact that this company is considering a large scale motorship programme. After having exhausted scientific and technical resources in the attempt to put their steamships on an operating basis of the utmost economy, they are apparently turning to the Diesel drive as the most effective solution for the problem of reducing cost.

In addition to the two ships referred to above, they are also figuring tentatively on two 10,000-ton vessels to be equipped with single-screw Diesel engines—possibly of the double-acting type. Like the two smaller ones, they are to be used for the transportation of steel products, but instead of running on the Great Lakes, they are to go all over the world and principally to the Far East.

Latest News of Motorship Construction Abroad

Twin 800 s.h.p. Sulzer Diesel engines will be installed in a 6,100 tons motorship building at the Kobe Steel Works, Kobe, Japan.

The twin 1,500 s.h.p. Sulzer Diesel engines for the tanker just ordered by the Union Steamship Co. of New Zealand, will be built at Winterthur, Switzerland.

ENTON, an 8,000 tons d.w. motorship was launched on Oct. 28th. at the Furness Shipyard, Haverton-Hill-on-Tees, England, and an 1,800 s.h.p. at 90 r.p.m. Wallsend-Sulzer Diesel engine is being fitted. The auxiliaries will be steam driven including the two turbo-blowers for scavenging the main engine cylinders. Her owners are the Avenue Steamship Co., London.

Swan, Hunter & Wigham Richardson have received an order for a sister 10,000 tons Neptune singe-screw 3,200 s.h.p.-Diesel engined tanker to the BRITISH MOTORIST.

An Armstrong-Sulzer Diesel engine of 1,350 s.h.p. will be installed in a 3,450 tons d.w. freighter to be built at the Armstrong-Whitworth yard, Newcastle-on-Tyne for Christen Smith's Rederei of Christiania.

PARKESTON is the name given to the new Diesel-driven ferry now building at Elsinore for service between Harwich, England and Esbjerg, Denmark.

Wilh. Wilhemsen of Christiania has ordered a 9,600 tons d.w. Diesel-driven freighter from the Brockenbau Flender Co., Lubeck, Germany.

Two 13,000 tons Diesel driven tankers have been ordered by the British Molasses Co. of Liverpool from the Furness Shipbuilding Co., Haverton Hill-on-Tees. Kincaid-Harland B. & W. twin Diesel engines will be fitted in both ships.

The Elder Dempster Co. has decided to go ahead with the two Diesel-driven passenger liners for its African service which it proposed sometime ago and which it provisionally ordered. Both ships will be of about 9,200 tons gross and of 8,000 i.h.p. in two 6-cylinder 4-cycle double-acting Harland B. & W. type Diesel engines. A grant has been made under the Trade Facilities Act for the construction of these ships.

Two More Big Passenger Motor-Liners Ordered

Twin double-acting Diesel engines aggregating 20,000 s.h.p., or 10,000 s.h.p. each, will be installed in two 18½-knot passenger motor-liners of 600 foot length, to be built for the Cosulich Line for service between Adriatic and South American ports. This order was forecast in our October issue. The hulls will be built at the Societa Triestina Navigazione, Monfalcone, Italy, which is the shipyard of the Cosulich Line, while the Diesel engines will be built under Burmeister & Wain license by the Stabilimento Tecnico Trieste. All arrangements for the design and construction of the vessels are in the hands of James M. Dewar and A. T. Wall, of London. These motorships will each have a gross tonnage of 20,000.

Prior to arriving at the decision to adopt oil-engines all alternative systems of propulsion were carefully studied, but the economies in favor of Diesel drive were so enormous that any form of steam propulsion seemed unwise.

Harland & Wolff Motorship Album

Harland & Wolff, Ltd., have published a handsome album reviewing the construction of their own and other licensees' ships powered with engines of the Burmeister & Wain design, 135 of such vessels operated by forty-six shipping lines being listed as of February, 1924. Their aggregate gross tonnage exceeds 700,000 and at the present rate of increase in construction, it will not be long before there are are 1,000,000 tons afloat.

The SELANDIA, the first ocean-going vessel with engines of this type, is mentioned as having covered approximately 600,000 nautical miles in the twelve years which have elapsed since she was first commissioned and there is no difference between the economy of her propelling plant then and now.

Over 400,000 i.h.p. Burmeister & Wain-type engines are afloat and more than 200,000 are in the course of construction. During 1923 more horsepower of this type was ordered from Harland & Wolff than during the entire preceding twelve years.

Motorship for Union Oil Co.

The contract for the small Diesel-driven tanker for the Union Oil Co. has been awarded to the Moore Dry Dock Co., Oakland, Cal. Twin 165 s.h.p. Enterprise Diesel engines are to be installed.

Two More Standard Oil Ship Conversions

Bids will be opened on December 15th by the Standard Oil Company of N. J. for the conversion to Diesel power of two 15,000 tons d.w. tankers of the J. A. MOFFATT, JR. class. These vessels are at present equipped with twin 1,500 i.h.p. reciprocating steam engines, which will be replaced by twin 1,500 s.h.p. single-acting Diesel engines. American shipyards and engine builders hope to secure this, which will stimulate the industry.

Motorship

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The World's Biggest Conversion Program

BENEFITS from the motor-vessels of the Shipping Board's Conversion Program will not be confined to a narrow group of individuals, but will inure to the whole nation. The immediate effect of the commissioning of these vessels will be a reduction in the annual deficit of the Board's operations. By placing the motorships into service on those long-distance routes which to-day look the least desirable and are the least remunerative, the Shipping Board can hope to make a showing that will eventually attract private capital for the absorption of those routes, which to-day are practically outside the pale of good economics. It may not prove immediately feasible to turn the losses on those routes into profits by the substitution of the motor-vessels for the steamers, but with the aid of time even that result may be achieved. During the interim, the Board will certanly be reducing its demands on the Treasury for the subvention of national shipping, an improvement which no taxpayer will fail to welcome.

Subsidiary to the influence of the Conversion Program upon national shipping as a whole is the benefit it can confer upon American shipowners. Their welfare, after all, is so closely interwoven with that of the nation's shipping that it should not be considered separately therefrom. For shipowners, the Conversion Program holds this great aid: namely, that it will enable them to purchase at a price a little below the world's market figure a motorship, or number of motorships of demonstrated reliability and of known operating costs without tying up capital while the craft are building. Only a part of the Board's price will have to be furnished at the time of sale, the remainder being lent by the Shipping Board.

The newly converted ships will have more advantages than merely economy of operation whilst at sea. They will have greater speed than the steamers of the same size. They will be equipped with the most modern cargo-handling equipment, which is to-day receiving its due recognition as one of the greatest benefits derivable from motorship operation. Compared with foreign motor vessels of the same size—which are almost exclusively of the twin-screw type—these ships, with their single-screw installations, will have smaller engine-room crews. This in itself will practically bring the item of engine-room wages in the foreign vessels and in the Shipping Board boats to a common level. No greater opportunity could reasonably be extended by any country to its shipowners than will be presented to American shipping under these conditions.

By the time the full program of the Board has been carried out, the United States will have the most up-to-date and efficient motor fleet of any country in the world.

Not only the shipping industry will reap benefits, but the two affiliated industries of shipbuilding and marine engineering also will derive advantage. The marine engine industry gets the financial encouragement so essential to it through the orders allotted to certain individual members of it. The shipbuilding industry has not yet felt the same encouragement, because the time is yet too early for the placing of the contracts for the engine installation work. Its time will come between six months and a year from now. Moreover, it is not beyond the bound of probabilities that the Shipping Board will, before long, agree with the view being urged upon it from within that a number of new motor tankers should be ordered for the purpose of accomplishing in the oil transportation section of shipping the same results which will be derived in the general freight section by the conversions already taken in hand. As there is a ready market for such ships,the Shipping Board may soon feel itself called upon to ask for bids on a number of tankers and their Diesel machinery, both from the Atlantic Coast and from the Pacific Coast. Furthermore, it is to be hoped that Congress will authorize the Board to construct the two high-powered Diesel-driven passenger liners which it recently planned, as we must keep abreast in this field, too. This would fill out a very well-balanced encouragement to the marine industries, besides strengthening the fleet on a profitable side.

On the operation of the ships that are to get double-acting engines, it is too early to make more than a passing comment. The Shipping Board has shown praiseworthy courage in embracing this type of engine in the program. To anticipate that this machinery will give entire satisfaction immediately upon commissioning would be to expect more than has been obtained at any similar distinct stage of development in the oil-engine art. There have always been minor troubles manifested when new types of engines were sent to sea. A little patience, a good determination and willing co-operation have always smoothed out the little difficulties without serious grief. The double-acting engines must be considered experimental to some extent, and such as there is of experiment is justified to the full by the end that is sought. Their inclusion in the program brings before shipowners the last development that can be expected of the oil-engine in its present form. There need no longer be any waiting for unanticipated developments. The oil-engine, as we know it to-day, can go no further, nor is there yet anything in sight that can supplant it.

Facts from Lloyds Speak for Themselves

THE wonderful annual growth of oil-engined motorships is shown by the table which we reproduce below from the Lloyds Register of Shipping's annual report for the year 1923-1924.

Motorships of Over 100 Gross Tons Now in Service

Date	No.	Gross Tons
July, 1914	297	234,287
July, 1919	912	752,606
July, 1920	1,178	955,810
July, 1921	1,473	1,248,800
July, 1922	1,620	1,542,160
July, 1923	1,795	1,666,385
July, 1924	1,950	1,975,798
Motorships Under Construction		
Sept., 1924	159	939,697
Grand Total		2,915,495 gross

tons or approximately 4,665,000 tons deadweight.

This table clearly indicates the steady and rapid increase of the large class of motor-vessel, it dealing only with craft over 100 gross tons. In July, 1914, there were less than a quarter of a million tons in service, whereas ten years later there were almost two million gross tons or more than three million

tons deadweight actually on the high seas. This is aside from thousands of oil-engined workboats, Rhine river vessels and the big Russian Diesel-engined fleet. To this we added almost one million gross tons of motorships now under construction registered by Lloyds, but not about 100,000 tons of vessels being converted, omitted from these figures by Lloyds.

President Coolidge, Our Foreign Trade and Ships

IN his address before the United States Chamber of Commerce on October 23rd President Calvin Coolidge pointed out that despite the tariff on imported goods which now reaches approximately $550,000,000 per annum, our export business has reached $8,000,000,000 per annum. Yet we are faced with the fact that the average eight-hour wage of some of the leading countries is as follows:

Italy	$ .96
Belgium	1.10
France	1.36
Germany	1.40
England	2.28
United States	5.60

President Coolidge also stated that in Germany it takes 23 men to move a ton of freight one mile, 24 men in Italy, 31 in Switzerland, while in the United States it takes only 5 men. In this is to be found the answer to the question, "How can American motorships built in American yards possibly compete on the high seas with ships built at lower cost and on a much lower wage scale in Europe, and with higher operating charges?"

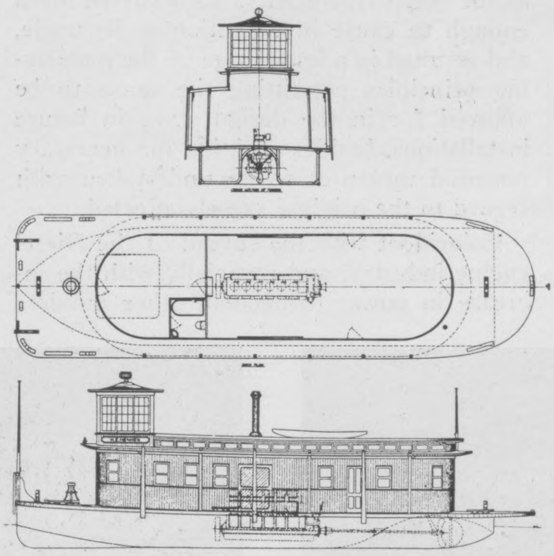
It is only a matter of a few more years before most of our ships will be more efficient in type, and will be handled just as efficiently as those of our more experienced European competitors. Loading and discharging cargo, methods of handling cargo on board ship and at the docks, and the dispatch of ships from port to port, will all be brought up to the highest pitch of efficiency. Our ship operators, navigators and engineers, are quick to learn and are rapidly becoming more efficient, and in ten years from now will not have to take lessons from those overseas. Our vessels will be Diesel-driven and will be equipped with the very latest types of auxiliary machinery, making them second to none. And,—we have oil fuel on the spot. We agree with Frank Munson that those who think otherwise are pessimists. Sufficient of us *are* sea-minded!

Ohio River Tunnel Stern Motor Vessel

Our readers will recall publication in MOTORSHIP several months ago of an illustrated description of the new design of airless-injection marine Diesel engine as developed by the Standard Motor Construction Company of New Jersey. One of the first units turned out from the plant, which hitherto has been engaged in the manufacture of large marine gasoline engines, has been installed in the Ohio River tunnel stern tug H. S. HENNEN, owned by Capt. H. S. Hennen of Evansville, Ky., who has written the engine builders expressing complete satisfaction with the operation of the machinery. Originally the H.S. HENNEN was equipped with a different type of internal-combustion engine, and the new installation shows a saving in fuel and lubricating oil.

The H. S. HENNEN, built in 1922 by the Midwest Boat and Barge Company of Grafton, Ill., has been especially constructed for shallow draft work on the Ohio River and is complete in all its respects, having ample accommodation for her crew, and is equipped with a towing engine.

The second day after the new oil-engine had been installed the boat made a trip to Louisville, Ky., making her first tow to Evansville, a distance of about 206 miles.



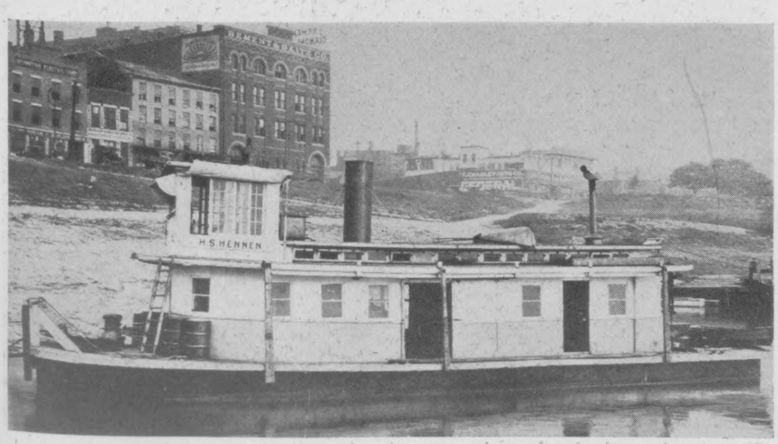
Plans of the "H. S. Hennen"

Judging by the results obtained up to the present time, the cost of the new installation will be covered in a very short time by the economies effected and the reliable service given.

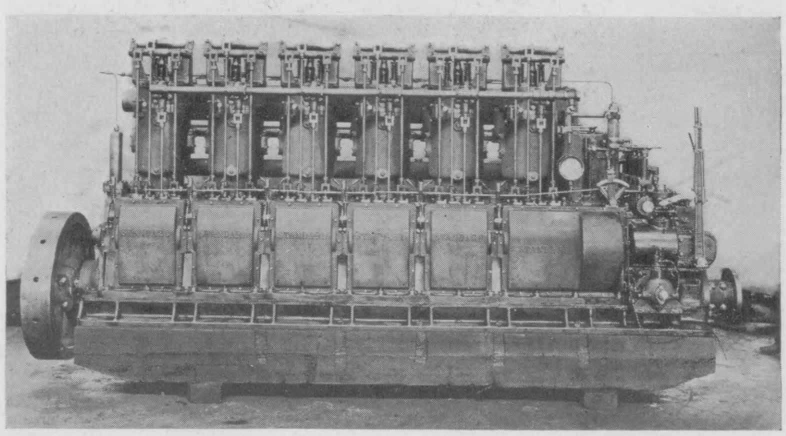
One new motorship, and a conversion of their steamer LAURENCE are contemplated by the Alaska Railroad, Anchorage, Alaska.

British Columbia Notes

The B. W. B. Navigation Co.'s tug, PROSPERATIVE, of Vancouver, is reported giving very satisfactory service towing logs with her 225 b.h.p. six-cylinder Winton Diesel, turning at 250 r.p.m., which was installed in place of a 160-i.h.p. fore and aft compound steam-engine last spring. The propeller that has been used is a four-blade wheel of 72-inch diameter and 48-inch pitch which runs at about 230 r.p.m. towing logs, but will turn at 300 r.p.m. when the tug is travelling light. A spare propeller is being made of the same area and diameter, but having three blades instead of four. The cost of fuel and lubricating oil for the Diesel engine is said to be just half the cost of operating the coal-burning steam engine she had before; while the towing power of the boat has been increased about 50 per cent. She handles a tow of twenty-four sections of logs, about a million feet board measure, comfortably. The engine is direct reversing, and is said to be capable of slowing down to less than 90 r.p.m., giving a very flexible control. Most of the auxiliary machinery is run by a 21 b.h.p. Vickers-Petter oil-engine, which operates the towing winch and anchor windlass through shafting and a chain drive.



Shallow draft motor-vessel powered with one of the first new eastern Standard oil-engines



The six-cylinder, four-cycle airless-injection oil-engine of the "H. S. Hennen"

Influence of Torsional Vibrations On Diesel Engine Crankshafts

How Mysterious Fractures Occurred, the Reason Discovered and the Cause Eliminated

(Contributed)

OF late a considerable amount of attention and publicity has been given to torsional vibration, chiefly in connection with double-reduction gearing for marine turbines and crankshafts of internal-combustion engines, so a review of this subject as related to crankshafts of Diesel engines is probably of interest.

About a year after Diesel engines were first commercially built and installed in Europe, crankshaft failures became in evidence. The cause was not understood at that time, and the failures were attributed to the occasional exceedingly high pressures obtaining in the cylinders on the firing strokes, which in those early days were known to occur far too often, due to the comparatively slight amount of control that could then be exercised over the injection, atomizing and burning of the fuel. The engine builders of that day strove to improve the combustion of the fuel, replaced shafts as they failed, and investigated materials until the conclusion was reached that some hitherto unknown phenomenon existed. Further research showed that at certain speeds, which differed in different installations, stresses were induced whose values were much in excess of normal.

Before long the original firms concerned, after painstaking investigation, deduced the governing fundamentals of the phenomenon, but not a great deal of attention was focussed on the subject by others, and the spread of the knowledge concerning it was slow. In fact, shafting failures in marine steam installations due to this cause continued to occur for years without arousing suspicion as to the real nature of the trouble, a very noticeable instance being the repeated failure of the line shafting in the U. S. Battleship CONNECTICUT.

Certain British submarines, prior to the World War, experienced difficulty with engine foundations and some of the electric motor shafts fractured. This occurred often enough to cause investigation to be made, and resulted in a knowledge of the underlying principles permitting the cause to be allowed for in the design stage in future installations, besides enabling the necessary remedial measures to be undertaken with regard to the original vessels affected.

Coincident with the spread of the Diesel engine industry, and especially with the increase in power demanded, other builders encountered the same experience. Apparently sound shafts of conservative design would unexpectedly fail, and they too, were forced to investigate.

A similar cycle of events occurred in connection with double-reduction gearing for marine turbines. Gears wore out with unprecedented rapidity and roared with disconcerting loudness. Lubrication, materials, inaccuracy of gear cutting, unsuitable tooth forms, distortion of gear frames, hogging and sagging of the ship, were all blamed in turn, and while in cases some of these were predisposing causes, yet finally the majority was ultimately recognized as being due to torsional vibration.

It was unfortunately true that most of the engine builders who had not had this sad experience, lacked knowledge regarding its effects, due to the natural reluctance of those that had from publishing information painfully and expensively acquired.

The New London Ship & Engine Company, of Groton, Conn., unwittingly encountered this experience a few years ago. Prior to this experience, some 120,000 Diesel s.h.p. had been built and delivered; some 15,000 of it to the British Government, and shafts designed by the usually accepted method and formulae had all been uniformly successful without any record of

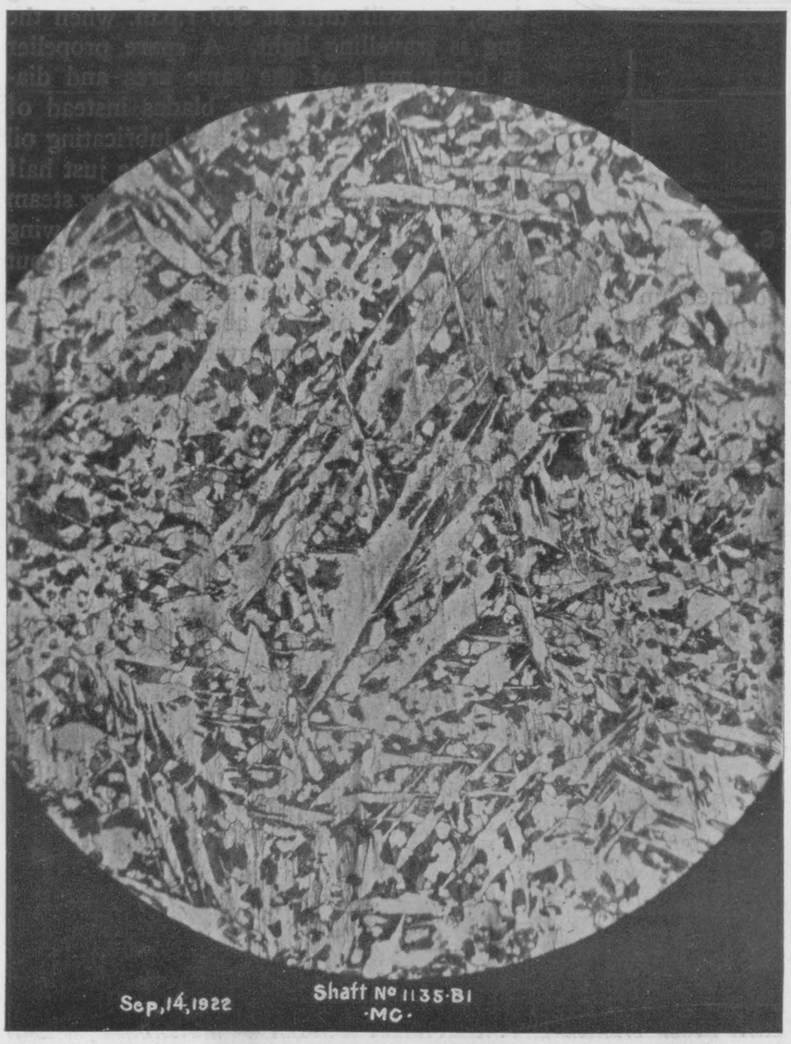


Fig. 1. Photograph of physical characteristics of material taken from crankshafts which fracture through torsional vibration

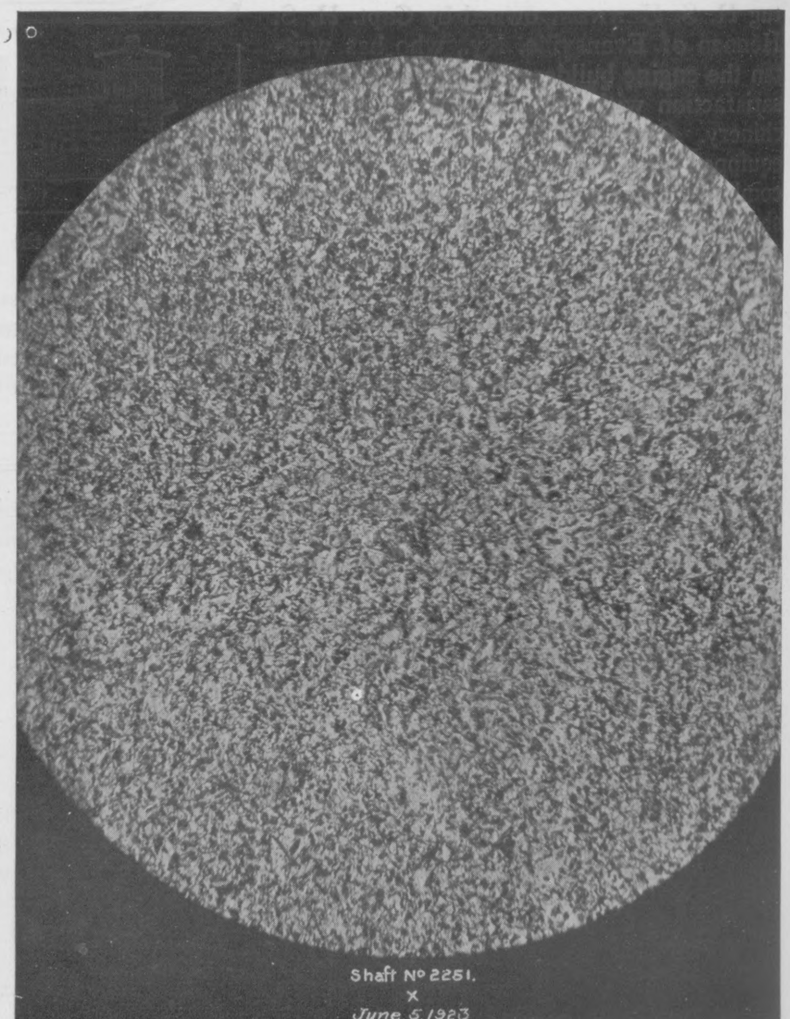


Fig. 4. A typical microphotograph of perfected material used in making crankshafts by the New London Ship & Engine Company

failures at all. As all shafts were amply strong, with larger factors of safety than many foreign designed and built submarine shafts, no particular attention was paid to this part of the engines in general until a fracture occurred in an engine for one of the U. S. submarines.

Examination showed that an undoubted flaw existed at the fracture which was of such a nature that it apparently fully accounted for the failure, so that the shaft was replaced, only to again fail at the same place. As mentioned above, the first fracture revealed a flaw, and naturally all subsequent cases were examined with great thoroughness. The material was put through all possible tests, and while a few shafts showed that the original physical specifications were met, yet metallographic examination showed undesirable structure even in these, but the greater number showed flaws, small elongation; very low Charpy test results; and a general lack of uniformity. As the steel used in the shafts was made at a time of great production and stress during the war, a certain amount of suspicion attached to it, and the question of replacing these shafts with undeniably good material became a burning question. Some microphotographs of material taken from these fractured shafts are shown in Fig. 1, whilst the physical characteristics are given in Table 1.

Meanwhile the Engineering Department had become very busy. First the design of the propulsive equipment as a whole was picked to pieces to find out wherein it differed materially from previous designs that had been eminently satisfactory. The outstanding difference seemed to be that these boats required a higher submerged speed, and consequently a proportionately larger motor armature than previous boats. That the shafts were failing through excessive torsional stress was clearly evidenced by the nature of the cracks or fractures which were always diagonal through the oil hole in the after main bearing, sometimes accompanied by small diagonal cracks starting from the oil hole in the after crankpin.

As the shafts had a large factor of safety insofar as normal torsional stresses were concerned, it soon became obvious that some abnormal condition was present. In this installation the engines were connected to the armature shafts by friction clutches and it was observed that these clutches manifested an undue tendency to slip at full speed; viz., 380 r.p.m., irrespective of the power being transmitted. It was also noted that no shaft failures occurred when operating with a slipping clutch, and that such failures were inevitable when the clutch did not slip and the engine was operated at full speed regardless of load.

At this point, the existence of torsional vibration began to be suspected and it was recognized that the rigid coupling of the engine to the armature shaft was a necessary condition precedent to the development of destructive stresses. Considerable time and effort were expended in experimenting with flexible couplings of the magnetic type and also with so-called vibration dampers, but only a minor degree of success was obtained.

During the course of the experiment, it was noted that the after main bearing showed a tendency to heat up as the engine closely approached full speed and it was concluded that this heating was due to excessive stresses in the crankshaft. Some special motormeters were built and installed at every main bearing and the engine was run throughout its speed range, the temperature of each bearing being noted every two or three minutes. The results were plotted and in this manner a graphic picture of the stresses in the shafting was produced. These pictures showed that at certain speeds in the running range the stress was dangerous and at others normal. They also showed that the amount of power the engine was developing had no effect

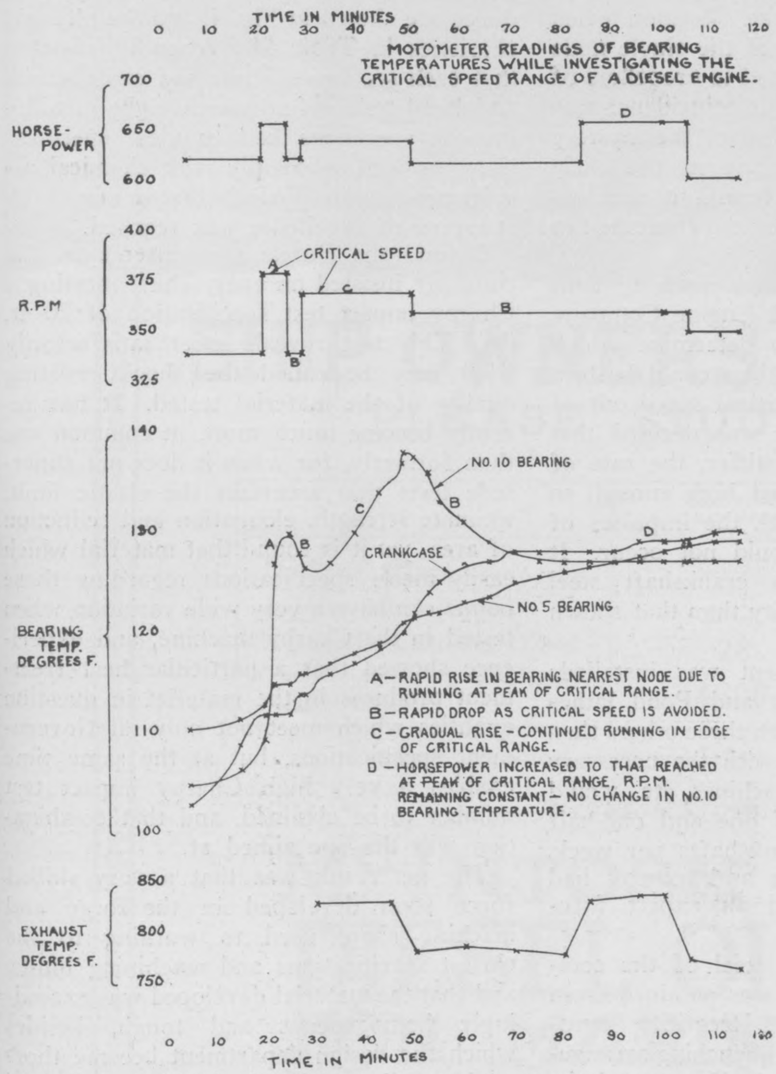


Fig. 2. Graphic picture of stresses in the shaft showing that at certain speeds the stress is dangerous and at other speeds normal

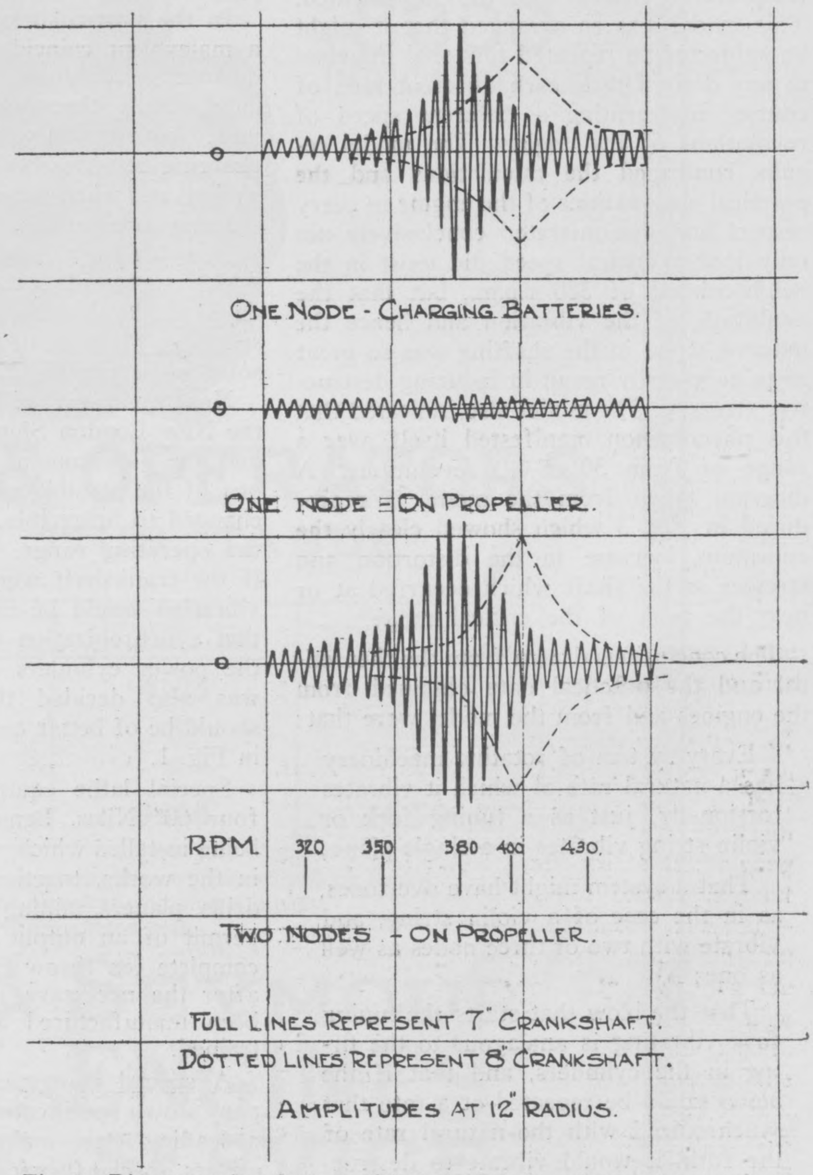


Fig. 3. Diagram taken from model shaft showing clearly the enormous increase in the distortion and stresses in the shaft which occurred at or near peak of the critical range

upon the intensity of stress at the "bad speeds." A typical plot of the readings obtained is shown in Fig. 2.

As soon as the existence of torsional vibration was seriously suspected, a method of calculating the critical speed for torsional vibration was evolved which, when applied to the particular equipment in question, indicated that such a critical speed did exist at about 380 r.p.m.

In order to check the calculation and the results of actual observations on the engine, a model was constructed in which all of the shafting, as well as all the rotating and reciprocating masses were duly represented. This model was so arranged that it might be subjected to repeated torsional impulses at any desired rate, each different rate, of course, representing a different speed of revolutions of the engine. The model results confirmed the calculations and the practical observations of the engine in every respect and demonstrated conclusively not only that a critical speed did exist in the neighborhood of 380 r.p.m., but that the amplitude of the vibration and hence the induced stress in the shafting was so great as to necessarily result in inducing destructive stresses. The model also indicated that this phenomenon manifested itself over a range of from 30 to 40 revolutions. A diagram taken from the model is reproduced in Fig. 3 which showed clearly the enormous increase in the distortion and stresses in the shaft which occurred at or near the peak of the critical range.

The conclusions drawn from the theoretical and the practical data obtained from the engines and from the model were that:

> Every system of rotating machinery has a natural rate at which it vibrates torsionally, just as a tuning fork or violin string vibrates in a single plane;
>
> That a system might have overtones, as in the case of a violin string, and vibrate with two or three nodes as well as one;
>
> That the blow that starts the tuning fork vibrating is analagous to the firing in the cylinders, and that if the blows could be repeated at a rate that synchronized with the natural rate of the fork, it would vibrate to destruction.

This theory seemed to be an answer to all the previously unknown quantities. For example, troublesome torsional vibrations have only appeared in recent years, because only in recent years had the engines been of high enough speed, and had enough cylinders to enable the impulses to come fast enough to synchronize with the natural rate within the operating range. Again, this particular type of submarine with the large armature got into trouble because this extra weight added at this point reduced the natural rate to such an extent that it coincided with the impulse rate in the operating range, while in previous installations it had come just above the operating range, and hence was never encountered or noticed. In a like manner, this theory explained all the heretofore baffling phenomena.

In ordinary machinery installations only one system of rotating weights and shafting is involved. This, however, is not the case in a submarine where two systems are involved, since when charging batteries the tail and propeller shafting are thrown out and the engine is driving the motor as a generator. It is consequently possible to have a submarine equipment satisfactory from the point of view of torsional vibration insofar as charging batteries is concerned, while unsatisfactory for propelling purposes, and vice versa.

In the particular case under discussion, a malevolent coincidence occurred in that destructive torsional vibration existed at substantially the same speed of rotation under both conditions, the vibration when charging batteries being of the single node variety and when connected to propellers of the two-node variety. This coincidence was responsible for a good deal of the mystery which surrounded the case in the early days of the investigation and it was responsible for most of the time consumed in solving the problem.

Next a careful study was made by both the New London Ship & Engine Company and the Government to determine which one of the possible variables could be best changed to bring this critical speed out of the operating range. It was decided that if the crankshaft were stiffer, the rate of vibration would be raised high enough so that synchronization with the impulses of the power cylinders would not occur. It was also decided that crankshaft steel should be of better quality than that shown in Fig. 1.

Special lathe equipment was installed; four 60″ Niles, Bement and Pond lathes being installed which, with three others then in the works, together with the necessary drills, planers, milling machines, etc., would permit of an output of one and one-half complete ten throw crankshafts per week, after the necessary jigs and fixtures had been manufactured and an expert force trained.

A special manganese steel of the company's own specification was obtained from a leading steel maker. Recording pyrometers, special furnaces, quenching arrangements were installed in the forge, and the work began. A crankshaft force was trained from amongst the company's own staff, and very soon after starting work, production was worked up until it exceeded the requirements.

The steel as forged into ingots at the mill underwent preliminary chemical analysis, after meeting the requirements of which it was delivered at Groton. There the ingots were parted by a planer into two pieces, the division taking place along the longitudinal axis. This idea was developed at Groton, and is for the purpose of eliminating any segregation or remains of the pipe that are nearly always present in the center of any ingot. It accomplishes this aim, inasmuch as no material that had formed part of the center of the original ingot remains in any part of a finished shaft after the forging, twisting and machining of the two sections which are made from the two halves, is completed.

At first a certain amount of difficulty was found in meeting metallographic requirements every now and then, but experience gained at the start of work, combined with the very helpful criticisms of Dr. McAdams, Jr., of the Experimental Station at Annapolis, soon resulted in a high standard of excellence being reached and maintained, as evidenced by the fact that the last 72 consecutive sections sent to Annapolis met the Bureau's metallographic specifications on their first submission, after having met all physical requirements before being so submitted. Typical microphotographs of the material for the shafts produced are shown in Fig. 4, and the physical charistics in Table II. When it is stated that each section of shaft had eight tensile and bend tests, after which eight metallographic specimens had to meet specifications, as well as comply with chemical requirements, it is obvious that a very high standard of excellence was reached.

Beyond the Bureau's requirements, the company insisted on every shaft meeting a Charpy impact test specification of 20 ft. lbs. This test reveals most satisfactorily what may be called the shock resisting quality of the material tested. It has recently become much more in common use than formerly, for while it does not supersede tests that ascertain the elastic limit, ultimate strength, elongation and reduction of area, yet it is found that material which easily meets specifications regarding these points can have a very wide variation when tested in the Charpy machine, and experience showed that a particular heat treatment produces in the material in question qualities which meet not only all Government specifications, but at the same time enables a very high Charpy impact test number to be obtained, and that combination was the one aimed at.

The net result was that a very skilled force soon developed in the forge and machine shop, used to working to the closest specifications and machining limits, and that the material developed was exceedingly homogeneous and tough, besides which the design department became thoroughly well acquainted with the phenomena known as torsional vibration.

Today the "bad speeds" at which torsional vibrations are excessive are known as Critical or Synchronous Speeds. The factors which have an effect upon the natural rate of vibration of a system, and consequently when taken as a whole determine whether the system is to have trouble or not are:

> Number of impulses per minute.
> Weight of revolving parts.
> Elasticity of revolving parts.
> Elasticity of the connecting shafting.
> Relative position of the masses along the shafting.

These factors apply, of course, to any

(*Continued on page* 905)

(*Continued from page* 900)

source of power; steam or internal-combustion reciprocating engines, steam or water turbines; and whether pumps, propellers or generator are driven direct or geared, and as any rotating system has a certain period of vibration, it therefore must have, in practice, certain critical speeds which, if within the operating range, it is the part of wisdom to avoid.

In order to calculate the critical speeds of an installation, the natural period of the system as a whole must first be ascertained. Several assumptions are generally made; for instance, that couplings are absolutely rigid; that a certain proportion of water is carried around with marine propellers, thus adding to the flywheel effect of the propeller proper; and that bearings maintain a certain degree of constraint on the revolving shaft. The elasticity of crank webs is calculated, after which the whole system is reduced to an equivalent shaft length with the various rotating parts acting at points along it. The frequency F is then given by:

$$\text{Frequency per minute} = \frac{60}{2\,\Pi}\sqrt{\frac{I \times C \times G}{\Sigma\, Wr^2\, l}}$$

Where I = polar moment of inertia of equivalent shaft.

C = modulus of elasticity (12,000,000)

G = gravity acceleration (386 in sec.^{2})

Wr^2 = polar inertia (lbs. in.^{2})

l = distance from node in inches of the various parts.

When the product of the number of impulses per revolution and the r.p.m. equals the frequency of the system, then, at that number of r.p.m. the system is at a critical speed. To illustrate this, suppose the frequency of a system driven by a four-cylinder four-cycle engine was 1,600 per minute when vibrating with one node, then, as the power impulses are two per revolution, 800 r.p.m. would be a critical speed. If it were a four-cylinder two-cycle engine, the critical speed would be 400 r.p.m. Similarly, with a six-cylinder four-cycle engine, the critical would be manifest at 533 r.p.m., and if two-cycle, at 266 r.p.m.

When an engine is designed to operate between certain ranges of revolutions, the frequencies of the system vibrating with one, two, three and more nodes are calculated, from which it is ascertained whether any critical speeds exist within that range. If they do, and are of the first or second degree, then the frequency must be changed. This is easily accomplished in the majority of cases by increasing or reducing the elasticity of the equivalent shaft; that is, by reducing or increasing the diameter of the actual shaft; or by altering the mass of the flywheel, or its position longitudinally; or by keeping the same size of shaft, but altering its length.

The easiest method, and that generally adopted, is to alter the diameter of some part of the shafting and if originally designed with ample margin of strength, this can be done by merely dimensioning some convenient length, for instance, a length of line shafting to a smaller diameter. By this means, the frequency will be altered, and the critical speeds can be moved out of the operating range. As, in general, machinery for warships is designed for maximum power with minimum weight, in their case only a very slight reduction of diameter of any shafting can be permitted, if at all, and so any change of sufficient magnitude would most probably have to be in the way of increase.

In addition to now being able to calculate the point at which critical speeds will occur in an installation while it is yet in the drafting room, it is also possible to calculate the magnitude of the stresses which will be produced at these speeds.

Today a new installation is carefully calculated to make certain that no dangerous critical speeds will occur, before any plans leave the drafting room. Then the crankshaft is very carefully made and tested and finally the installation as a whole is carefully examined with the aid of torsiographs and vibrographs of Dr. Geiger's design; which were first used by the M.A.N. in investigating similar problems. This procedure insures that there can be no possibility of the purchaser of the engine being troubled by destructive torsional vibrations.

TABLE I

Crankshaft A

Elastic Limit	*Tensile Strength*	*Elongation*	*Reduction of Area*	*Charpy*
Lbs. per sq. in.	*Lbs. per sq. in.*	*Per Cent*	*Per Cent*	*lbs. ft.*
44,850	74,550	26.5	51.1	9.11
48,300	73,450	24.2	51.9	6.15

TABLE II

Crankshaft B

Elastic Limit	*Tensile Strength*	*Elongation*	*Reduction of Area*	*Charpy*
Lbs. per sq. in.	*Lbs. per sq. in.*	*Per Cent*	*Per Cent*	*lbs. ft.*
43,100	76,900	35.1	65.4	28.1
45,550	77,600	34.3	64.9	30.1

Motorships Stimulate Overseas Trade by Reducing Cost of Carriage,

Says E. S. Gregg, Chief, Transportation Division, U. S. Department of Commerce

Before issuing statements, the various departments of the Government are usually very careful to make exhaustive investigation, hence the recently issued remarks on the motorship question by E. S. Gregg, of the Department of Commerce, may be accepted as an accurate summary of the real situation:

"Today," says Mr. Gregg, "the motorship is the most efficient transportation unit. Although a new motorship costs approximately 25 per cent more than a steamer of similar size, it can carry goods from 10 to 30 per cent cheaper.

"These facts in themselves are perhaps not very interesting to the exporter. He should, however, keep informed of developments along this line, since he is to-day benefiting from the low rates that have resulted in part from the effective competition of motorships with steamers. In the near future the trade of the world will indubitably tend to increase more rapidly, because the motorship is cheapening the cost of ocean transport as surely as the steamer did in the 'eighties of the past century."

American Yachtsman Purchases Motorship "Svealand"

It will be recalled that in the pictures illustrating our October issue story of the trials of the Pacific Mail Steamship Company's motorship City of San Francisco at Gothenburg, could be seen Allison B. Armour, who is well known in this country as a yachtsman and scientist. Mr. Armour has purchased the Polar Diesel-engined motorship Svealand from the Swedish East Asiatic Company. This vessel is now being converted at the Eriksberg Shipyard, Gothenburg, from a freighter to virtually a floating palace, which will include a laboratory. The twin Diesel-engines will be retained, but a donkey-boiler will be arranged with oil-fired equipment for heating the ship. Many new cabins, each with bathroom, are being installed. It is understood that the first voyage of this vessel will be an expedition to the South Seas.

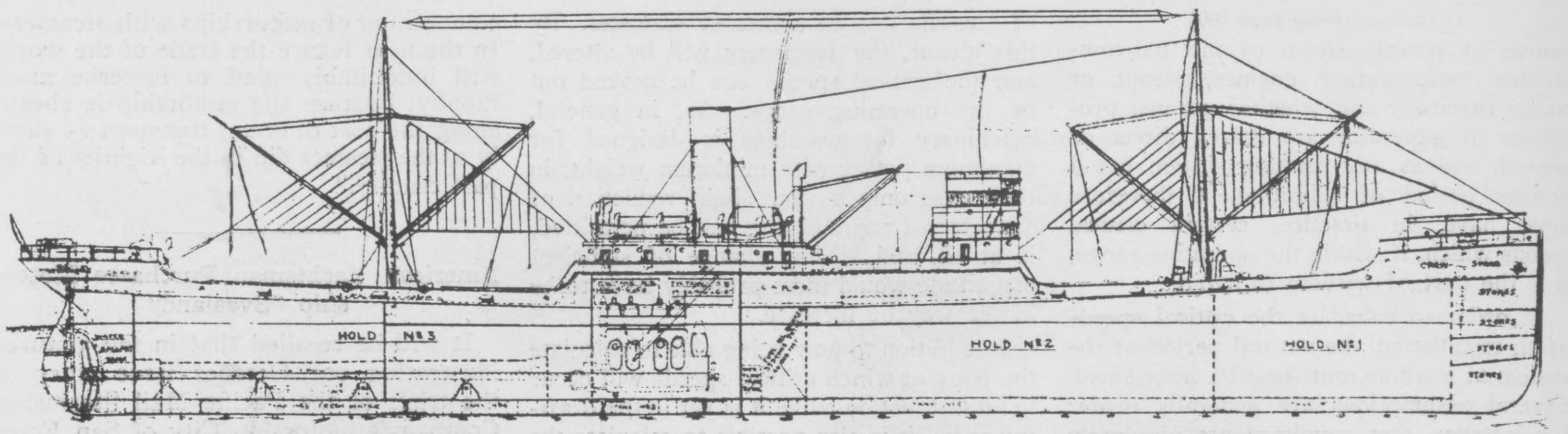
Two Piston-Ring Concerns Consolidate

The close business relations which have existed between the Piston Ring Co., of Muskegon, Mich., and the No-Leak-O Piston Ring Co., for eleven years, are well known throughout the industry, and the former company also manufactures the No-Leak-O piston rings has been established for some time.

Beyond the actual manufacture of the rings, the two organizations functioned on an entirely individual basis, with the No-Leak-O Co. concentrating all its efforts on the grooved ring field and the Piston Ring Co. on the plain ring field.

The agreement has expired and because of the growing demand for oil rings, negotiations were begun several months ago looking toward the consolidation of the two companies, with the natural resulting benefits and economies inevitable in such a consolidation. This has been accomplished and was put in effect November 1, 1924.

L. P. Iverson, Manager of Service Division of the Piston Ring Co., will continue in that position in which he will have general supervision of the Service Branch of the business, but will devote his time principally to the Quality Plain Ring department, while the No-Leak-O and Sealdrain rings will be combined in a department with Quality Drainoil rings under the management of L. G. Matthews, Treasurer of the No-Leak-O Co., who will be assisted by John E. Norwood, Jr., son of the inventor of No-Leak-O Piston rings. A specially designed ring for oil engines is manufactured.



Inboard profile plan of the converted ship "Wieringen," ex-"Turbina" showing present machinery arrangement

Second Dutch Steamship Converted

Rotterdam Steamship Company Changes 5,600-Ton Steamer for Purpose of Training Engineers for Operation of Big Rotterdam Lloyd Motor-Liner INDRAPOERA

HOLLANDERS unquestionably are conservative, but at the same time they are very thorough, and when they undertake anything they do it well and without half measure. This was indicated in the past by the hesitation of many of the leading Dutch shipowners to take up the Diesel engine for motorship propulsion, and by the extensive manner in which some of them lately have gone about the construction of motor vessels.

It will be recalled that the second motorship ordered by the Rotterdam Lloyd is the INDRAPOERA, a twin-screw passenger liner of 16,000 tons displacement, 7,000 s.h.p. and 15 knots speed, the freighter KEDOE being their first. This company, in order to have a staff of engineers trained for the operation of the particular type of Diesel engine selected for the big vessel, namely the Sulzer, arranged for its subsidiary the Stoomvaart Mij. Rotterdam to have converted to Sulzer oil-engine power its cargo steamer the TURBINIA, the name of which has just been changed to the WIERINGEN. This ship will be used for carrying cargo in an efficient manner, as well as for training engineers. The work of conversion was to have been expedited owing to Sulzer-Freres of Winterthur having an engine available of the power needed. Work, however, was delayed, due to some changes having been necessary to the double bottom of the hull when altering the engine foundation. Consequently the conversion work occupied a full year. The steam plant of the TURBINIA consisted of two boilers with H.P. and L.P. turbines and a single reduction-gear which has operated satisfactorily with good fuel economy since placed into service in 1915. A gradual increasing wear of the teeth probably would have made the renewal of pinions and teeth run necessary within a few years.

The plant of the De Schelde Company, Vlissingen, Holland, is building the larger Sulzer Diesel engine of the INDRAPOERA.

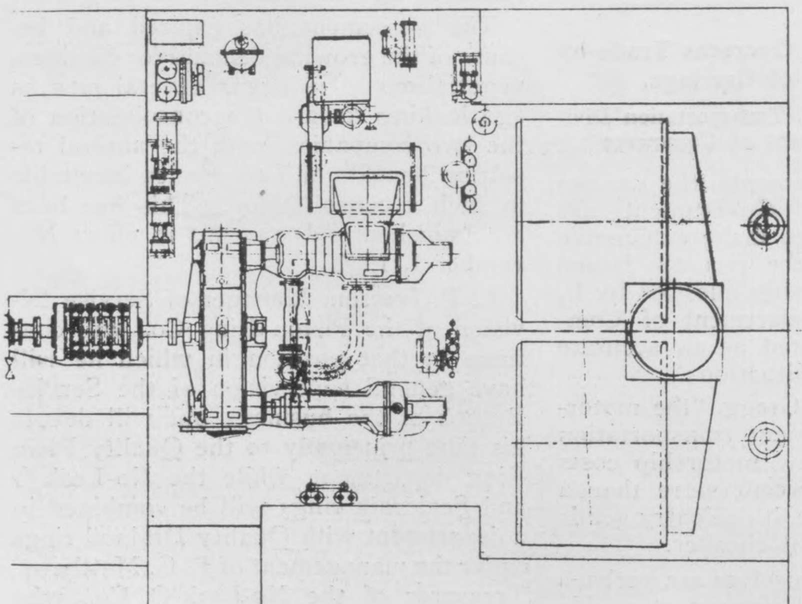
The dimensions of the WIERINGEN are as follows:

Deadweight capacity	5,600 tons.
Power	1,150 s.h.p.
Engine speed	85 r.p.m.
Daily fuel consumption	5 tons.
Engine cylinder bore and piston stroke	600 x 1060
Length, b.p.	331′ 0″
Breadth (moulded)	48′ 0″
Depth (moulded)	24′ 6″
Loaded Draft (mean)	20′ 9″

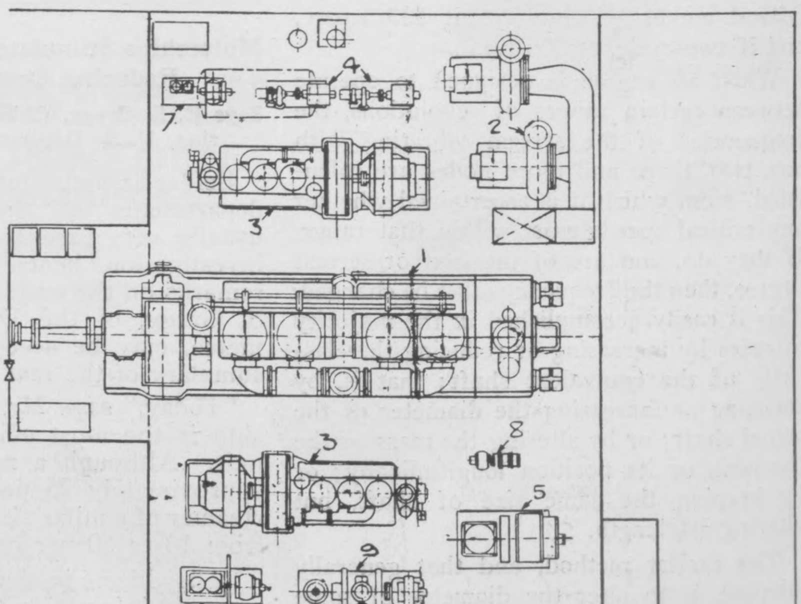
Trials took place on October 11th, on the New Waterway, and the vessel immediately left for Buenos Aires, arriving at Las Palmas en route on October 19th. Although the power of the vessel is low, for her tonnage, namely 1,150 s.h.p., a speed of 9.35 knots was averaged with the ship fully loaded on its non-stop run.

The weight of the complete machinery is 24 tons more than previously, but of course there is a considerable saving on the weight of fuel to be carried for a long voyage.

Her present bunker capacity is 371 tons, or sufficient for 70 sailing days, whereas her previous bunker capacity was 446 tons of coal or sufficient for



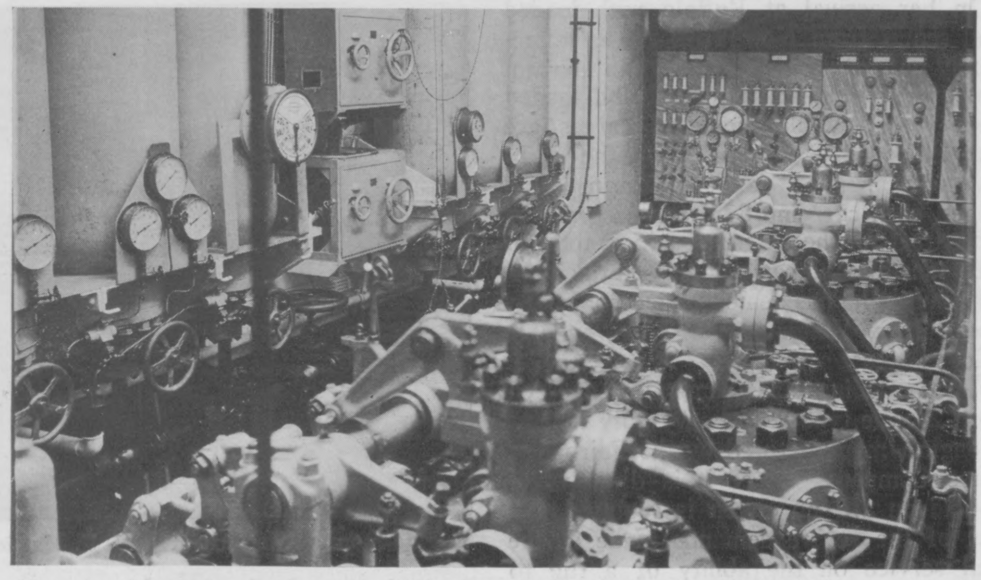
Engine and boiler rooms of the "Wieringen" formerly the steamer "Turbinia" prior to her conversion to Diesel power



Engine-room of the "Wieringen" following her conversion to single-screw Diesel power

about 18 days. Calculated on a basis of 18 sailing days the net deadweight cargo gain is 314 tons. Her drawings show the difference in space occupied by the machinery, approximately one-third of the engine-room space being gained. Furthermore, the entire space in the bridge deck which originally contained coal bunkers is now available for cargo.

While the main engine has its own blast-air compressor scavenging is by two independent turbo scavenging compressors of the Brown-Boveri design. For auxiliary purposes there are two Sulzer four-cycle engines 150 b.h.p. at 300 r.p.m. direct coupled to D.C. generators of the Electro-Slikkerveer type. In addition there is a Kromhout oil-engine driving a 9 K.W. dynamo for lighting, and when in port. This engine is also connected to a small emergency compressor.



View in the engine-room of the "Wieringen" showing upper deck platform controls and gauges

Economical Tug Service on New York Barge Canal

Commissioning of the "W. F. Mattich" With Heavy-Duty Oil Enigne is Bearing Out Former Predictions in Regard to This Form of Power on Barge Canal

COMPLETE details are available concerning the equipment of an important oil-engined tug boat which has been placed in service on the New York State Barge Canal. She is the W. F. MATTICH, designed and built by the Globe Shipyard of Buffalo, N. Y. Because of the inefficient service rendered by the ordinary kind of steam craft hitherto generally used on the Canal, it looked for a time as though New York's $100,000,000 investment might be hard to realize on. The use of oil engines for canal craft, however, is showing operators how to achieve success with canal transportation enterprises and it may be confidently expected that the use of this modern form of prime mover will not only save the big Canal investment, but will draw from it a profitable yield as well. The W. F. MATTICH, powered with a Fairbanks, Morse oil engine, shows in a concrete way how this tendency is taking shape.

General dimensions of the W. F. MATTICH are as follows:

Length	65 ft. 0 in.
Beam	17 " 0 "
Depth	8 " 6 "
Draft Fwd.	8 " 0 "
Draft Aft.	10 " 0 "
Speed (Light)	11 miles

The hull is surmounted with a pilot house, is fitted with the usual engine casing, and has the galley aft. Quarters are provided for a crew of 7 men with a shower bath, toilet, and individual steel lockers.

Particulars of the propelling plant are as follows:

Engine	One Fairbanks, Morse Type C-O
Stroke	18 in.
Bore	14 "
Engine Speed	250 "
Engine Power	200 s.h.p.
Cylinders	4

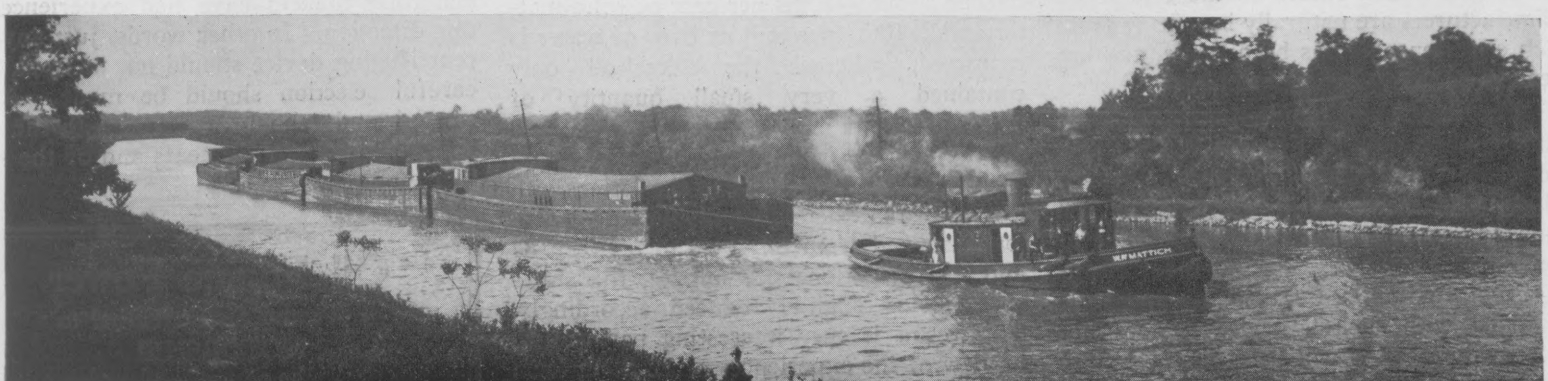
A Trout semi-steel 3-blade 70-inch diameter 44-inch pitch propeller is fitted. Four tanks for carrying a total of 16 tons —4,500 gallons—of fuel are built in and give the tug a cruising radius of 325 hours at full power. In terms of miles this amounts to over 3,000, a figure which must surely catch the attention of the man who owns a non-condensing coal-fired steam tug.

Nothing has been overlooked in equipping this vessel with a good line of auxiliaries, a list of which is given herewith:

9 Air Tanks, 20″ x 60″
1 Winton Generator Set, 5 Kw., 7½-h.p. Gasoline Engine
1 Burke Electric 5-Kw., 1,200-r.p.m. Generator (Chain-Driven from Propeller Shaft)
1 Link-Belt Co., Silent Chain
1 1½″ Taber Pump
1 3-h.p. 1,200-r.p.m. General Electric Motor
1 4½″ x 4¼″ Compressor, 6-h.p. Electric Motor
1 600-Amp.-hr. U. S. Headlight Storage Battery
1 Cutler-Hammer Switchboard
1 Globe Shipyard Electric Steering Gear, 3-h.p. Motor
1 Carlisle-Finch Electric Search Light (250-Watt Bulb, 1-Mile Range)
1 Strombos Air Whistle

We learn on good authority that the tug has given complete satisfaction, both from a mechanical and from a financial point of view. Whereas the operation of steam craft on the canal has in the past resulted in financial loss and has encouraged the erroneous view that the great waterway might be a losing proposition, the oil engined boat is showing how the deficit can be converted into a surplus.

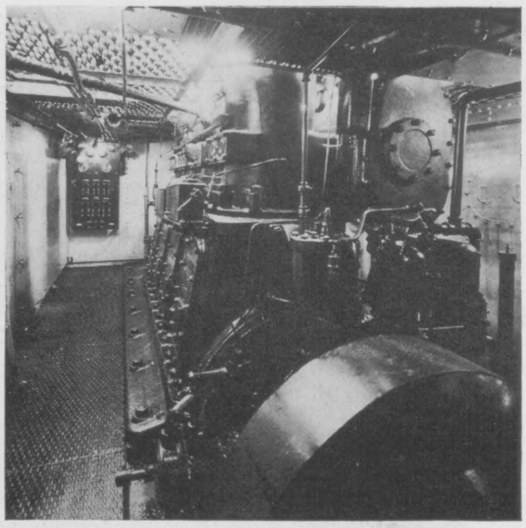
It is stated that the W. F. MATTICH has never lost a day since the season opened, a record which no steam tug could have duplicated. Coaling, ash-removal, and scaling takes up time on a steam tug which is equivalent to several days' loss of operating time from the total number of days available during the canal season. On the oil-engined boat there are no fires to be cleaned; no firemen in the crew; and the W. F. MATTICH is always ready to go.



Oil-engined tug "W. F. Mattich" towing four fully laden barges on the New York State Canal

On her arrival at Buffalo with loaded sand scows from New York she is immediately put to work near the grain elevator maneuvering and shifting light and loaded grain vessels while the sand barges are being unloaded. As a regular tow the W. F. MATTICH handles four 1,000-ton canal barges, each carrying 825 tons of grain on 9′ 6″ draft on the eastward trip, a total of 3,300 tons of sand being hauled on the westward run. She has demonstrated her ability to run from Waterford to Tonawanda in six days actual sailing.

Her propelling plant consists of a 4-cylinder, 2-cycle type C-O heavy-duty marine oil engine, manufactured by the Fairbanks, Morse Company. Since it is directly reversible on air, no clutch is required. In view of the severe demands made in the canal service on the ability of a tug to carry out protracted and complicated maneuvers, the success of the system appears to have been amply demonstrated by the service which has already been given.


Engine-room of the Canal tug "J. F. Mattich"

During the past season the W. F. MATTICH has given her owners an opportunity to satisfy themselves on this point. When it is recalled that the New York State Barge Canal averages one lock to every eight miles of straight sailing and that the tows must be arranged and rearranged before and after passing each lock, it becomes apparent that the tests to which the W. F. MATTICH was subjected provided ample opportunity for obtaining conclusive results.

Worthy of special mention is the fact that the men who are handling this boat have had no previous oil engine experience. Since the trial trip was run, no mechanics from the engine manufacturers have been aboard her, a fact which speaks well for the simplicity and reliability of the machinery. It lends support to the belief, also, that an intelligent steam engine operator can promptly adapt himself to the oil engine service.

Sea-Going Try-Out of Centrifuges With Boiler and Diesel Fuels

Experiences of a British Motorship With American Fuel-Oil

ONE of the most interesting problems confronting motorship-owners of today is that of the fuel question and of being in a position to meet all the changing conditions of the fuel market. Careful study of the situation has caused MOTORSHIP to recommend that no large or medium powered Diesel installation be carried out without including a centrifugal purifier for the fuel-oil as part of the equipment, in addition to a duplicate purifier for handling the lubricating oil.

Experiences today show that while performances of such devices are not yet 100 per cent perfect, results are such that the initial expense is really an economical investment and that many years will be added to the life of the engine and additional reliability ensured. Furthermore, a motorship thus equipped is in a position of being able to take on not only what fuel-oil may be available, but any grade of oil that can be burned satisfactorily under steam boilers; provided, of course, the necessary fuel-oil heating devices are fitted in conjunction with the centrifuge and for which the exhaust gases of Diesel engines can be utilized.

Where such a policy has been followed, the results have in every way endorsed our recommendation. Even better results are anticipated in the future as the centrifuge manufacturers are naturally benefiting from such experience as has been made, and are steadily improving their machinery.

Our Vancouver representative recently paid another visit to Furness-Withy's single-screw motorship PACIFIC SHIPPER which was described in MOTORSHIP last June and in which reference was made to the use of a Sharples centrifuge for cleaning the fuel-oil. Because a vessel is equipped with such a device it does not necessarily mean it will be economy to use the heavier fuel at all times and under all conditions. In the case of the motorship PACIFIC SHIPPER, her owners have a contract for boiler-oil at San Francisco for $1 per 42 gallon barrel, and for Diesel-oil $1.15 per barrel.—reports our correspondent.

On her maiden voyage from European ports to the West Coast of North America this vessel used a Diesel-oil of about 24 degs. Beaumé as fuel, across the Atlantic to the Canal when she took on boiler-oil both at Balboa and San Francisco. This was used on her return trip to Europe and back again to the Pacific Coast, her low consumption enabling her to take sufficient fuel for a round trip.

On the maiden trip the Diesel-oil was passed through the centrifuge before using, and a certain amount of solid matter was removed. On the subsequent voyage the heavier boiler-oil was also run through the centrifuge before burning. Mr. Coller, Chief-Engineer of the ship, advised us that the machine took up the work splendidly and he has no fault to find with it. On the other hand, when passed through the centrifuge about 7/10ths per cent of solid matter and 2/10ths per cent or over of water is extracted, whereas the Diesel-oil only contained a very small quantity of hard asphaltum. Furthermore, it was found upon changing from Diesel-oil to boiler-oil there was less heat value in the latter, with the result that the engine revolutions at full load dropped from 87 down to between 84 and 85 revolutions per minute, the ship's speed being slightly reduced accordingly. This result is very interesting particularly in view of the experiences of L. B. Jackson of the Texas Company in conjunction with its motor-vessels and outlined on page 76 of the MOTORSHIP Conversion Supplement. It will be recalled that Mr. Jackson advised that fuel-oil of 20 degs. Beaumé is superior to Diesel-oil of 28 to 30 degs. Baumé and that a barrel of this said fuel contains approximately 85,000 b.t.u.'s more than a barrel of Diesel-oil, and that, generally speaking, the engines ran better on the heavy oil. This would indicate that oils vary considerably and that the mere term "boiler-oil" or "Diesel-oil" does not really indicate much in this direction unless proper analysis is made. Generally speaking the head units increase with the gravity of the oil.

But the lesson to be learned from the sea-going tests with the PACIFIC SHIPPER is that the ability of a motorship to use boiler-oil is a distinct advantage, particularly for a vessel calling at ports where Diesel-oil is either not available or is comparatively expensive. The fitting of a centrifuge does not necessarily mean that a vessel should use boiler-oil at all times because beneficial results can be gained even if Diesel-oil is used almost exclusively and run through the purifiers prior to its injection into the engine cylinder. This, of course, is on the assumption that well-designed, well-constructed and reliable centrifugal devices are adopted for this purpose and their makers have had experience in this direction. In other words, just any oil centrifuging device should not be used, but careful selection should be made. Also, careful study should be made with the exhaust heating arrangements and of the system of piping.

Modern Cattle Ship Has Single 2,700 S. H. P. Diesel Engine

Power of Vickers Engine Is Developed in Eight Cylinders at 110 R.P.M. With Conservative Mean Pressure

IN the irresistible sweep of progress now being made in the construction of motorships it is easy to lose sight of the fact that by no means all of these newer vessels are of the same general type. The motorship boom, which is now apparently in the beginning stage, is giving enterprising manufacturers the looked for opportunity to incorporate into increasingly larger ships the trial and observation results which have been gathered, mostly over long periods of time, from smaller vessels and machinery. Therein lies real progress, and the evidence now at hand showing that manufacturers are positively enlarging their stock-in-trade is alone sufficient to support a high degree of confidence in the success and permanence of the motorship industry.

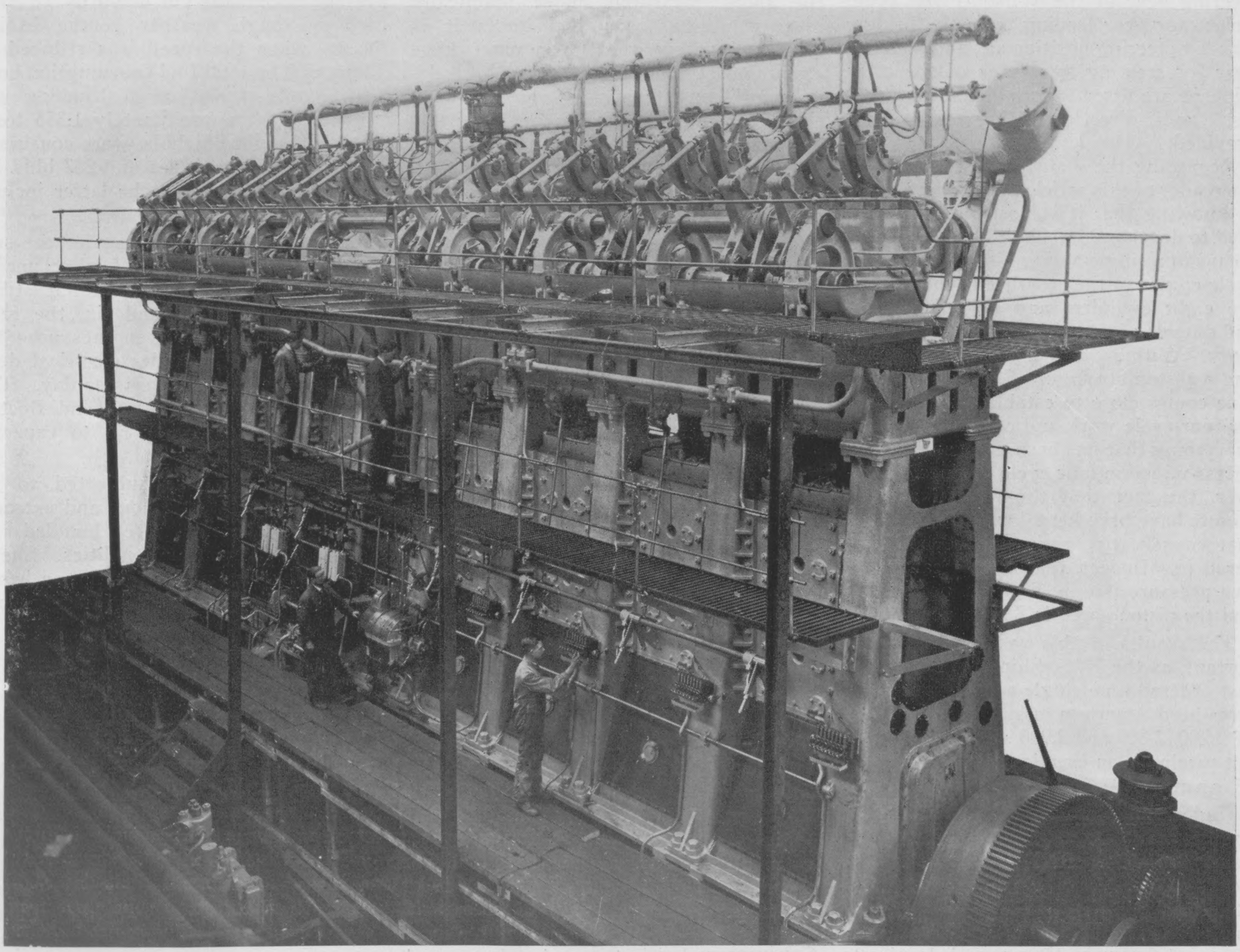
One of the many concrete examples of this tendency is plainly apparent in the construction of the hull and propelling machinery of the MOVERIA, newly launched by Vickers, Ltd., at Barrow-in-Furness, England. In this vessel a new type of double-bottom structure has been employed, and she is propelled by the most powerful airless-injection slow-speed, single-acting four-cycle Vickers oil engine which has been built to date. Although the hull construction adheres in a general way to the usual transverse frame system, the design of the double bottom has been carried out by the use of the Vickers - Wingate longitudinal - braced frames. The latter make it possible not only to maintain the full strength of the hull, but also to secure a construction which is lighter and more open than those which are commonly employed.

With a dead-weight tonnage of 7,500, the MOVERIA has taken her place among the most important of single-screw vessels which are driven by four-cycle single-acting engines. Her length, too, which amounts to almost 400 feet, establishes a record for a cattle-carrying motorvessel. Particulars and principal dimensions are given in the following table:

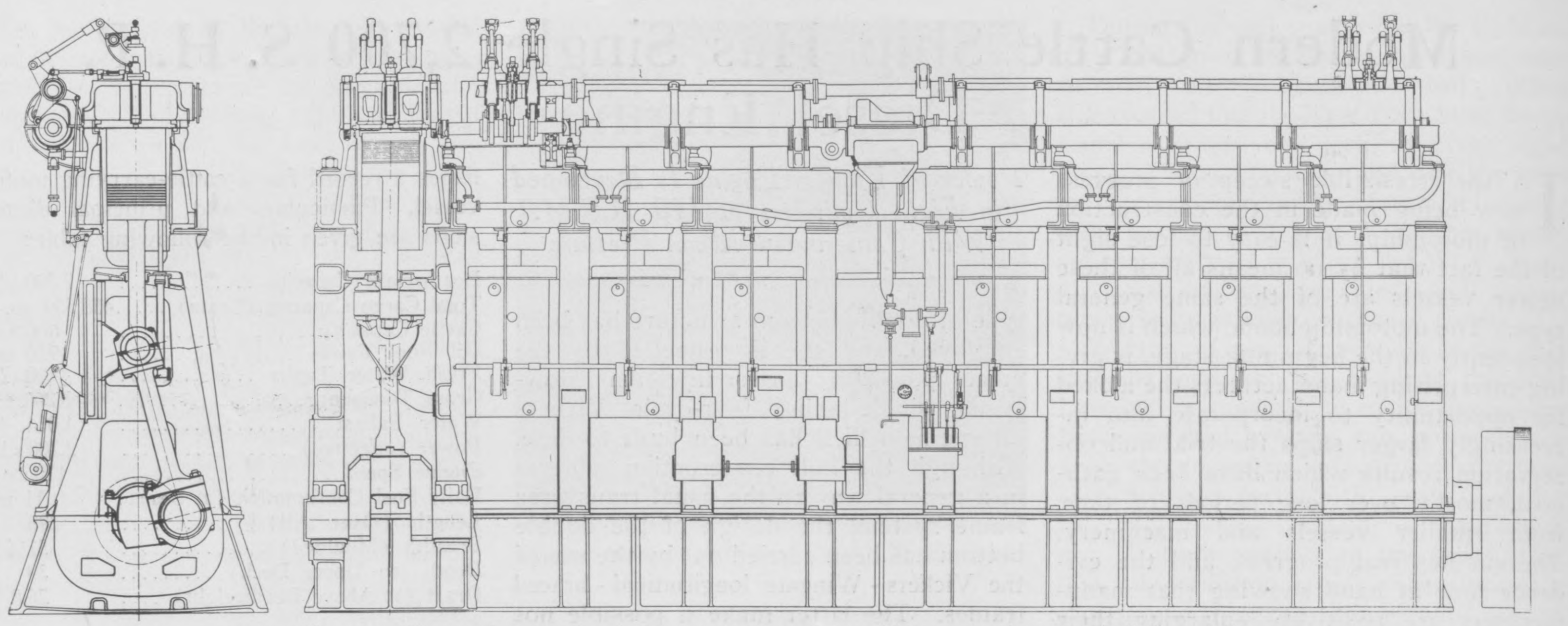
Deadweight Capacity	7,500 "
Total Cargo Capacity (Grain)	438,530 cu. ft.
Cattle Capacity	600 head
Oil Fuel Tanks	950 tons
Fresh Water Tanks	100 "
Gross Tonnage	5,200 tons
Water Ballast	1,016 "
Power (effective)	2,700 s.h.p.
Engine Speed	110 r.p.m.
Daily Fuel Consumption (at Sea)..	11 tons
Length (Over All)	398 ft.
Breadth (Moulded)	51½ "
Depth (to Upper Deck)	39 "
Draft (at Above Deadweight)	26.8 "

Of the total cargo space available, over 170,000 cubic feet are refrigerated, and therefore suitable for the transport of meat. More than 600 head of live cattle and the fresh water necessary for supplying them can be carried, and provision is made for allowing the animals to walk into and out of the ship.

A complete set of rapid cargo handling appliances are carried. Two hatches with



The highest-powered Vickers type merchant marine oil-engine yet constructed. It develops 2,700 s.h.p. at 110 r.p.m., and is installed in the cattle liner "Moveria"



Cross section and general arrangement plan of the Vickers engine of the "Moveria"

insulated hatch trunks are fitted to each insulated hold and 14 steam winches of the 7-inch x 12-inch size are provided for handling the cargo. The derricks are fitted to the two masts and derrick posts, two of these on the foremast being of 10 tons' capacity and the remainder being designed for 5-ton lifts.

Mounted on the upper deck aft is a steering gear of the Wilson-Pirrie type. Telemotor gear leading from the bridge, standby steering position aft, and standby gear for steering by means of the after winches are fitted. Both signalling wireless and direction-finding radio are provided.

Regarding the main propelling engine, the reader of this article may be interested in knowing that it is possible and practical to develop 2,700 shaft horsepower by means of a single-acting direct-drive four-cycle engine of the crosshead type. There are eight cylinders and no compressor, and outside of that the dimensions tell the story. With a cylinder bore of 30 inches and a piston stroke of 45 inches, this engine comes close to establishing a record for four-cycle work and certainly eclipses everything that has been done so far with airless-injection four-cycle engines. However, the fact that the revolutions per minute have been kept down to 110 shows that conservative ratings have been adhered to. In fact, the brake mean effective pressure is only 76.4 lbs. per sq. in., and the piston speed is 825 ft. per minute.

The results of this vessel will be important, as the U. S. Shipping Board has just ordered nine single-acting, four-cycle cross-head American marine Diesel engines of 2,700, 2,800 and 2,900 s.h.p. respectively, but turning at an even lower speed, namely, 95 r.p.m.

Underlying the design of this Vickers engine are the operating results which have been secured to date from the NARRAGANSETT and SEMINOLE, of the Anglo-American Oil Co., and SCOTTISH STANDARD, SCOTTISH MAIDEN, SCOTTISH MUSICIAN and SCOTTISH MINSTREL, belonging to Tankers, Ltd., all of which have a deadweight capacity of 10,000 tons and are powered with twin Vickers engines giving a total of 2,500 s.h.p. to each ship. To date these vessels have aggregated nearly a million miles of sailing under all sorts and conditions of weather at an average speed of 10.1 knots between pilots and a daily fuel-consumption of 9.67 tons. When it is recalled that the trial trip speed of the ships, measured under practically ideal conditions was 10.5 knots it is readily apparent that they must have maintained their ratings with a high degree of consistency. If a 10½-knot steamship of this tonnage averages 9½ knots in actual service and on 30 tons per day, she is considered to be doing well.

Large as the size and dimensions of the latest Vickers engine may therefore appear, it is nevertheless safe to say that its design does not constitute an innnovation. Undoubtedly the safest indications on which to base the manufacture of any engine are the accumulated operating experiences gained from similar machines previously built, such as those which have given so good an account of themselves in the six ships already mentioned.

Centrifugal purification of lubricating oil and fuel oil is one of the lessons taught by the operation of these vessels; it is not surprising, therefore, to find that twin Vickcen separators will constitute a part of the auxiliary equipment for the MOVERIA's 2,700 horse-power engine. As was indicated in the opening paragraph of this article, the MOVERIA is in many ways a sign and a symbol of the motorship epoch which has now definitely arrived.

The "Challenger" Completes Round-the-World Voyage

After loading at Philadelphia, New York and Boston, for a second voyage around the world, the 11,620 tons converted Shipping Board cargo vessel CHALLENGER has just started on her second voyage. She recently completed her maiden voyage around the world. During this cruise a total of 31,000 tons of cargo was handled, and her record for loading was broken at Philadelphia when in one day she handled 1,589 tons. The approximate distance traveled during this trip was 25,000 nautical miles, the average speed being just over 10 knots, more than 11 knots being attained at times. Her average speed was cut down by 18 days of very rough weather in the Indian Ocean, when the speed was reduced to 5 knots. The total fuel-consumption both for propulsion and cargo handling was 9,484 bbls., or approximately 1,355 tons. Of this amount 351 bbls. were consumed by the auxiliaries at sea and 237 bbls. by the auxiliaries in port, the latter including harbor work.

During the recent loading for the second voyage of 8,000 tons of miscellaneous cargo at Philadelphia, including structural steel, ammonia and tin, the fuel-consumption of the oil-engines used for generating power for her electrical deck winches was three barrels per day. The cargo loaded at New York and Boston practically brought her up to capacity before sailing.

The winches were subjected to all kinds of weather conditions and extreme temperatures, and were handled by stevedores of many nationalities. She is operated by Norton Lilly & Co. on behalf of her owners, the Sun Shipbuilding Company.

Diesel Engines For Airships

Apropos of our Editorial on oil-engine liners of the near future on page 816 of our November issue, announcement has been made that the new 1,000,000-ft. dirigible to be built by the Goodyear Zeppelin Corp., Akron, Ohio, will have Maybach Diesel engine as motive power. An illustrated description of the Maybach high-speed Diesel engine is to be found in the November issue of our sister journal Oil Engine Power. A few copies are still available, price 25 cents.

Scavenging Control of Swedish Two-Cycle Diesel

Valve Area Is More Than Half That Of Piston and Permits Low Air Pressure To Be Used. Scavenging Pumps Consume But Little Power

IN MOTORSHIP for June of this year, there was published an extended description of the Swedish Nobel Diesel powered tanker ZOROASTER and her four-cylinder two-cycle engine of 1,600 s.h.p. Outstanding features of this unique installation are its complete and self-contained engine auxiliaries, the shortness of the engine structure, its unusually high mechanical efficiency, its original scavenging system and compression relief valve gear.

A mechanical efficiency of 80 per cent or more is not often attained in two-cycle engines and there appears to be reason for believing that this is due in the present case to the method of scavenging employed. As may be seen from the power curve which was published on page 418 of the June issue, only 3½ per cent of the indicated work of the engine is used up in the scavenging pumps. The only explanation for this would be the very economical use of scavenging air made possible by the method of scavenging control characteristic of this design.

As will be recalled, the inlet or scavenging ports of the Nobel engine are controlled by a large mechanical valve, although automatic valves are provided as spares. Consisting essentially of a piston valve, large areas are secured by the use of multiple pistons arranged on a common body in such a way as form a grid or cage. This is clearly illustrated in the line-drawings which are reproduced herewith and which depict an engine having a bore and stroke of 26 inches by 36¼ inches.

It is apparent to the eye that the multiple piston valve has a diameter considerably greater than half the cylinder diameter; as a matter of fact, it measures 15 inches. Since each of the three circumferential slots or gaps is 19/32 inches high, the total area through them exceeds 300 sq. in. Now the area of the 26$\frac{9}{16}$ inch piston is only 555 sq. in., and the valve area is equal to more than half of it.

If the opening is more than half that of the cylinder bore, it is readily apparent that a column of air passing it will need to be only twice as long as the piston stroke in order that it may have a volume equivalent to that of the piston displacement. According to our calculations on page 420 of June MOTORSHIP, a little less than 1/6 of a second would be available for both exhausting and scavenging in an engine running at 105 r.p.m., and, as the outrush of the exhaust is quick, considerably more than half of the 1/6 of a second is available for the admission of fresh air through the valve. In the absence of exact experimental data, it is justifiable to assign 1/10 of a second as the duration of the scavenging process. But the valve is not full open all the time, since its grids are edge to edge at the commencement of scavenging and its net time-area factor is only about half as great as though it were full open all the time. In view of this, 1/20 of a second would be a conservative value to assign to the effective duration of the scavenging air blast.

Twice the stroke is a trifle over 6 feet and if this distance is traversed in 1/20 of a second, the air speed must be 120 ft. per second. It takes only 3¼ inches of water-column pressure to produce an air velocity of 7,210 ft. per minute, or very nearly 120 ft. per second. Reduced to the more familiar pressure units, this amounts to 0.12 lbs. per sq. in., a low figure. Naturally, there are a variety of flow resistances through the valve grids and the cylinder ports which make this figure greater in practice and it must be borne in mind also that the scavenging pumps deliver about 30 per cent more than the cylinder can hold in order to sweep it out thoroughly. Indeed, the purpose of this calculation is not to give any precise figure for pressure actually required, but rather to indicate a fact already well known, namely, that large air passages and low scavenging pressures are impossible one without the other.

Low pressures, of course, are awkward for maneuvring at low speeds, because the ports are open a long time while the piston is traveling slowly. If there is not

Mechanical details of Nobel port-scavenging two cycle engine. The scavenging valve at the left has a variable opening for slow running; the mechanically-operated compression relief valve at the right carries the safety valve within its hollow stem

much pressure to start with, running at reduced speed is apt to be troublesome on account of insufficient scavenging pressure.

This tendency is neatly counteracted in the Nobel design by one of the mechanisms illustrated. Referring to the section through the valve gear, it is apparent that the scavenging-valve rocker lever is pivoted on an eccentric. For slow running the latter is positioned in such a way as to prevent the ports from opening wide, with the result the air is economized and the pressure maintained.

Low scavenging-air pressure made possible by the use of large valve areas and sustained at slow running by a simple modification of the valve motion is apparently responsible for the fact that this engine uses up only 3½ per cent of its indicated power for pumping scavenging-air and accounts to a considerable extent for the attainment of a mechanical efficiency exceeding 80 per cent.

Just in passing there might be mentioned an unusual design feature connected with the compression relief and safety-valve gear on this engine. From the cross-section, it is apparent that the safety valve is mounted inside the hollow body of the compression-relief member. During the starting period, the entire valve is depressed at intervals by the rocker lever, in order to vent some of the compression, which escapes through the pipe into the scavenging trunk—another aid for keeping up the scavenging-air pressure during maneuvers. Should an undue rise in pressure occur within the cylinder, the inner cup-shaped valve will be lifted off its seat against the square-wire spring and the gases will escape through the hollow inner stem and out into the atmosphere through holes in the spring-cap. Compression relief while starting is therefore cam-operated and positive. This arrangement is simple and compact and, as it does away with the need for high-pressure starting air, permits the use of riveted air starting tanks.

Interesting Notes and News From Everywhere

World's Record of New Construction, Ships' Performances and Other Matters of Note in the Motor Vessel and Oil Engine Industries

TRIALS of the 11,000 tons Beardmore-Tosi Diesel-engined ship, SILURIAN, were run on October 30th.

Four new Diesel-driven motorships are proposed for the Isthmian Lines of the U. S. Steel Corporation.

The price paid to the Shipping Board for the 10,250 tons d.w. tanker, LIO, by the General Petroleum Corpn. was $153,750.

Recent quotations on Diesel fuel-oil in England at various ports were £4-17-6 per ton, while the price of boiler-oil is £3-17-6, or about $4.60 cheaper per ton.

CARNARVON CASTLE will be the name of the 20,000 tons gross motorship now building for the Union Castle Line at Harland & Wolff's shipyard, Belfast.

The new motorship VOGTLAND, building by Blohm & Voss for the Hamburg-America Line, left Hamburg on October 5th on her maiden voyage to the Far East.

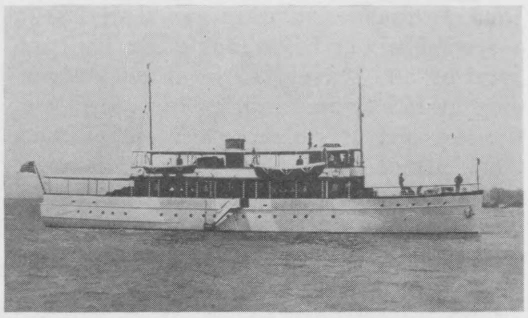
Richard F. Howe, an American yachtsman, has ordered a 550 tons Diesel-driven yacht from Ramage & Ferguson, Leith, designed by F. Gordon Pratt, of Cox & Stevens, London.

The Werkspoor Diesel-engined motorship, TOSCA, is now being operated by Winge & Co. between the Pacific Coast of America and South American West Coast ports.

The 20,000 tons motor-liner, AORANGI, is due to sail from Vancouver on February 11, 1925, on her first voyage across the Pacific, following her maiden voyage from Scotland.

A large Diesel-driven meat carrier of a special class will be built for the Houlder Line by the Fairfield Shipbuilding & Engineering Company, in which Fairfield-Sulzer oil-engines will be installed

The A/B Nobel of Helsingfors have ordered a 550-ton motorship from the Nüske shipyard at Stettin, Germany, in which a 400 s.h.p. two-cycle oil-engine is to be fitted.



Robert Oakman's (Detroit, Mich.), 120 ft. motor yacht "Mamie O," built in 1923 for Great Lakes cruising and powered with twin 180 s.h.p. Nelseco Diesel engines

For passenger service on the Lower Oder two motorships are to be built for the Emil Retzlaff Shipping Co. at the Stettin-Oder shipyard. The make of Diesel engine is not reported.

Launching of the 6,600 tons d.w. motorship BORGESTAD took place at the Burmeister & Wain shipyard on October 30. She is to the order of the Borgestad A/S of Porsgsund, Norway, and has twin 1,100 i.h.p. B. & W. Diesel engines.

In the new ferryboat, ACORN, the Oak Harbor-Utsalady ferry, a 75 s.h.p. Diesel engine has been installed. She is 65 ft. long by 25 ft. breadth, and can carry 16 automobiles. Her owners are Olson Brothers of Oak Harbor.

Two 8,600 tons motorships, to be equipped with Burmeister & Wain Diesel engines, have been ordered by the Gerolimich Steamship Company from the Cantieri Navali Triestina at Monfalcone, which is the shipyard of the Cosulich Line.

A 300 s.h.p. Fairbanks Morse oil-engine will replace the steam machinery in the tug, GOODWIN 14, built at Tottenville, N. Y., in 1909. She is a wooden boat, 85 ft. 3 ins. long by 26 ft. beam and 10 ft. draft, and has a gross tonnage of 143 tons.

The question of using Diesel-electric generators for auxiliary power on existing steamships is now being taken up abroad. It will be recalled that a plan of this nature was very fully discussed in MOTORSHIP several years ago.

SOUFFLEUR, CAIMAN, NARVAL and MORSE are the names of four 3,000 s.h.p. 1,148 tons French submarines building at the Cherbourg dockyard. The SOUFFLEUR was launched recently and is powered with twin 1,500 s.h.p. Diesel engines.

DIESEL will be the name of the new dredge now completing for the United Dredging Company, Galveston, Texas. This vessel has a 1,150 b.h.p. McIntosh & Seymour Diesel engine which, by the way, will be equipped with a Maxim silencer.

The first 125 s.h.p. Sumner oil-engine built by the Markey Machinery Company of Seattle is now ready and will shortly be installed in the new tug for the Tacoma Tug & Barge Company. A duplicate engine has been commenced at this plant.

The Russian Soviet has included in its program the conversion at Leningrad of two steamers to Diesel-driven tankers. It is understood that many new vessels of the forthcoming fleet will be oil-engine powered. The Soviet has appropriated five million rubles as a subsidy.

For a new State-owned ice-breaker in Sweden bids are to be invited alternately for Diesel-electric drive and for oil-fired steam. The vessel will have twin propellers, one forward and one aft, and will be of about 2,000 i.h.p. The order will be placed by the Swedish Admiralty.

TOURCOING, one of the numerous motorships for the Wilhelm Wilhelmsen Line, has

run her trials, and has been delivered by the Odense Shipyard. The vessel is of 9,500 tons d.w. and equipped with two 8-cylinder 4-cycle Burmeister & Wain Diesel engines aggregating 5,100 i.h.p.

According to a published statement attributed to J. Philbin, manager, Department of Sales of the United States Shipping Board, there have been many inquiries for the conversion of Shipping Board vessels to motorships, and the outlook for sales in this direction is good.

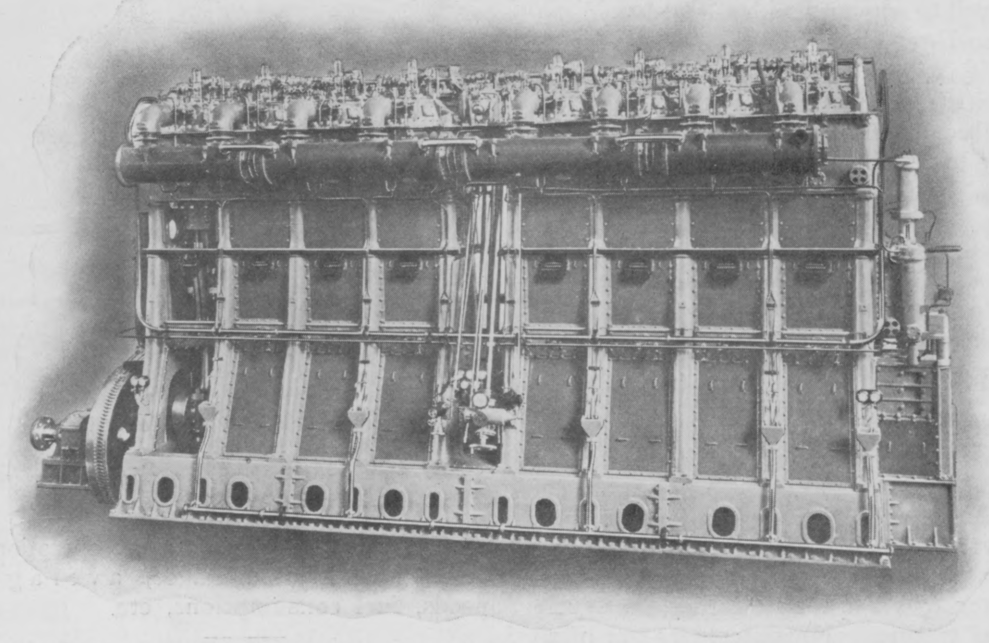
ODENSE, a motorship of 6,000 tons deadweight, has just been completed for the United Steamship Company of Copenhagen by the Elsinore Shipbuilding Company. A six-cylinder, four-cycle Burmeister & Wain type Diesel engine of 500 s.h.p., built by the Holeby Diesel Motor Works, is installed.

The twin gasoline engines of 45 b.h.p. in the yacht, VICTOR, have been replaced by two 50 b.h.p. twin-cylinder reversible Bolinder oil-engines. These engines were ordered by the United Fruit Company on behalf of R. H. Goodell, Tela, Honduras, manager of their subsidiary, the Tela Railroad Company.

EURYMEDON, Alfred Holt & Co.'s new twin-screw 10,000 d.w., 4,800 h.p. motorship, was recently launched at the Caledon Shipbuilding & Engineering Company's yard, Dundee, Scotland. This vessel, which was especially constructed for the Eastern trade, is 425 ft. b.p. by 54 feet md. breadth, 32 ft. 8 ins. depth and of 13½ knots speed.

The 6,600 tons d.w. steel motorship, LENFIELD, was recently launched at the Neptune yard of Swan Hunter & Wigham Richardson, Ltd., to the order of E. J. Sutton & Co., Ltd. This vessel, which is 370 ft. long by 51 ft. 3 ins. breadth, will be equipped with a Neptune, two-cycle, four-cylinder single-acting engine of 1,500 b.h.p.

In a tug now building for the Jersey City



New design of eight-cylinder single-acting four-cycle type Werkspoor Diesel engine built by the North Eastern Marine Engineering Co., Ltd., Wallsend-on-Tyne, England. Note how the open crank-pit steel-column design has been replaced by the enclosed combination cast-iron frame and steel tie-rod construction with oil tight crankcase

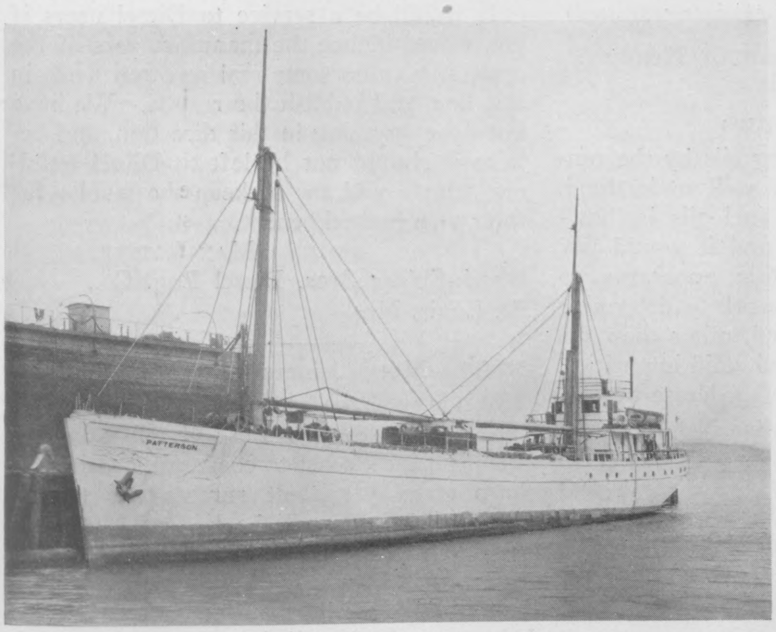
Stock Yards Company at the Crowninshield Shipbuilding Company, Fall River, Mass., a 400 s.h.p. Ingersoll-Rand oil-engine will be installed. The tug will be in service about April 1, 1925, and will operate on the Hudson River between the Jersey City Stock Yards and various points in New York Harbor

In reproducing Lloyd's figures of new ship construction for the quarter ending September 30, 1924, in our last issue, there was one more significant fact which we could have dwelt upon at length—namely, that for the first time in history the tonnage of motorships commenced throughout the world has exceeded the tonnage of steamships on which work was started.

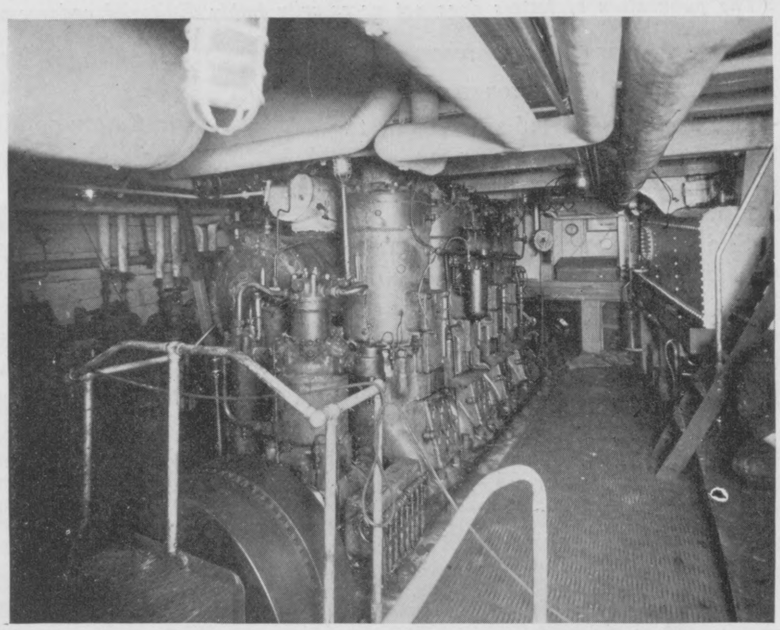
In consequence of the difficulties experienced in connection with the provision of sufficient financial support, the work of the Committee of the British Research Association for liquid fuels for oil-engines has been abandoned. It is to be hoped that some practical means will be found to continue the valuable work of the Committee at no distant date.

In the 50-ft. auxiliary motor ketch, ALICE, of Newport, R. I., owned by Henry Howard of Cleveland, Ohio, a 15 b.h.p. single-cylinder Bolinder oil-engine driving a reversible propeller has been installed. The work was carried out at A. C. Brown & Son's yard, Staten Island, N. Y. At the same plant Henry Howard's ketch, CARIB II, has just been equipped with a similar engine.

ZENITH, a 69-ft. halibut schooner built by Olson & Sunde Marine Works for John Iverson and C. M. Iverson of Seattle, was recently launched. A 90 s.h.p. Washington-Estep Diesel engine is being installed. Another halibut schooner—namely, the 72-footer for Ehler Brothers and Armstrong of Seattle—is being constructed at this plant



American wooden motorship "Patterson" recently equipped with an oil-engine. Wooden vessels of limited tonnages are always practical



Engine-room of the "Patterson" showing Bolinder engine which was removed from the now Diesel-powered steel auxiliary "Moonlite"

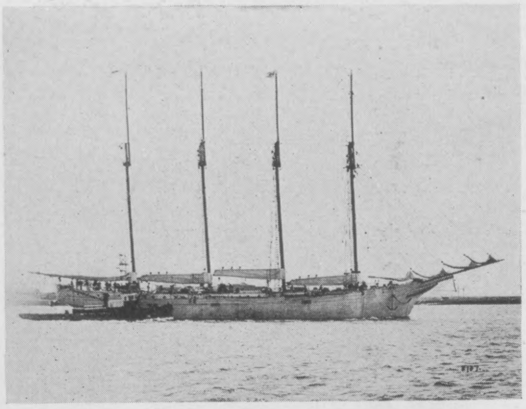
and will be equipped with a 100 s.h.p. Washington-Estep oil-engine.

KAIMILOA, formerly the schooner LUZON, has been equipped with twin 110 s.h.p. Atlas-Imperial Diesel engines and has run trials. She is now owned by M. R. Kellum, Fort Meyer, Fla., and was built in 1900 at Alameda, Calif. She is of 512 tons net, 170 ft. long by 37 ft. breadth. The vessel is due to start on a scientific expedition to the South Seas. The oil-engines give the vessel a speed of 7½ knots.

Norwegian ship owners, says the Scandinavian Shipping Gazette, have ordered 35 ships, aggregating 263,100 tons (of which 31 are Diesel motorships) from shipyards outside of their own country. Twenty-six of these craft will have Burmeister & Wain single-acting four-cycle Diesel engines. Four steamers out of so many vessels are significant signs of the times.

For installation in a towing and supply boat for pile drivers, Allen Spooner & Sons, Pier 11, North River, New York, have purchased the first of the new six-cylinder, direct-reversible 150 b.h.p. Fairbanks-Morse oil-engines. The OSPRAY, as this vessel is named, is at present equipped with a 125 s.h.p. gasoline engine. The higher powered oil-engine will give the vessel increased speed, and at the same time reduce her fuel bill to a very great extent.

The Japs are doing what it seems to have occurred to few shipowners to do before. In the motorships ATAGA MARU and ASUKA MARU the Nippon Yusen Kaisha have two 10,000 tons sister vessels of exactly the same lines, and of 4,000 s.h.p. each. One is equipped with two-cycle Sulzer Diesels and the other with four-cycle Burmeister & Wain Diesels. Careful check will be kept on their operation, overhaul and maintenance, average speeds, fuel consumptions, etc.



About to start on a scientific expedition to the South Seas—"Kaimiloa, ex-"Luzon," recently equipped with twin 110 s.h.p. Diesel engines

The winners of the cash prize contest of the Sperry Gyroscope Company, Brooklyn, N. Y., which called for a title for a picture showing Metal Mike (Gyro-Pilot or automatic steering device) in control of the wheel with a phantom of the traditional quartermaster standing at the wheel were Master F. B. Parsons; Capt. William R. Leith; Chief Mate Walter G. Hodgins; Everett D. Saunders; Master Robert E. Hudgins, C. M. Christensen, Gordon B. Rabbits and Lieut. Kenneth L. Coontz.

A. C. Shumway of Lima, Peru, agent for the Ford Motor Company, recently ordered a four-cylinder 100 b.h.p. Bolinder oil-engine to replace the 100 h.p. gasoline engine in his yacht, WINONA. The gasoline engine was installed in 1906 and gave the vessel a speed of 12 miles; whereas the new engine is expected to give a speed of 14 miles. The WINONA is 92 ft. long overall, 89 ft. on the water line, with 13½-ft. breadth and 4½-ft. draft on a displacement of 42 tons. The engine, which only weighs 9,600 pounds, will swing a three-bladed 38 in. x 48 in. propeller at 425 r.p.m

Before the British Institute of Marine Engineers' annual dinner, recently held in London, Sir Wescott Abell, Chief-Surveyor of Lloyd's Register of Shipping, stated: "The motorship is more than with us. We are proud to think of the success of the last 14 years. This innovation is more an economic revolution than it is a mechanical revolution. We still have an engine and a funnel. To parody Kipling:

Your fuel is new, and your air pumps are strange,
But, mechanically speaking, I see no change;
And in less than a week—if she did not ground—
We'd sail such a hooker the wide world round.

"This seems to me the spirit in which the sea people deal with all the new innovations; they approach them with their heritage, and the difficulties disappear."

Results from the use of a centrifuge for cleaning the oil fuel on the Doxford-engined motorship, SYCAMORE, were recently published in *Shipbuilding and Shipping Record,* as follows: "Using oil with a rather high ash and water content, it was found that the percentage of ash was greatly reduced by passing the oil through the centrifuge while the water was practically eliminated. An analysis of the deposit from the bowl of the centrifuge showed 48 per cent of water, 7.9 per cent of ash, and 45 per cent of oil, the water containing 3.3 per cent of solids in solution, a proportion closely corresponding to that in sea water. Further, the 0.102 per cent of ash found in the original oil was reduced to 0.016 per cent, an amount usually found in dry oil, it being thought that much of the ash content of wet oil is probably due to salts dissolved in the water. The value of the centrifuge is found to be most marked when the oil is inferior or irregular in composition."

Our Readers' Opinion

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

Steam Tug Converted

To the Editor of MOTORSHIP:

We have converted our steam tug MARIAN to crude oil motor and would be pleased to let you have the particulars as to her performance.

She now has a 100 h.p. Fairbanks-Morse CO engine. Her hull is 52 ft. 6 in. long, 13 ft. beam, 6 ft. 5 in. depth. We have overhauled her woodwork on house and hull thoroughly and she makes a very pretty job.

The writer is a subscriber to the MOTORSHIP, and I take this opportunity of expressing the pleasure I get from reading the many interesting articles in the magazine on motor-vessels, as well as the valuable information I have obtained.

ROLAND D. PHILLIPS.

Towing and Lighterage.
Baltimore, Md.

Centrifugal Treatment of Heavy Fuel-Oils

To the Editor of MOTORSHIP:

Treatment of lubricating oils by the centrifugal method is pretty well understood. The treatment of heavy fuel oils is, however, very little known; and it would pay the manufacturers of this apparatus to carry out some research work to determine what may be accomplished, other than the mere removal of water and solid impurities. I have a feeling that, to a moderate degree, this process may act as a sort of mechanical refining, and, if it has not already been done, it would be worth while to try it out on very heavy and highly viscous fuel oils—recording the effect of centrifuging on the gravity, viscosity, and heat value, and the reduction in volume or weight.

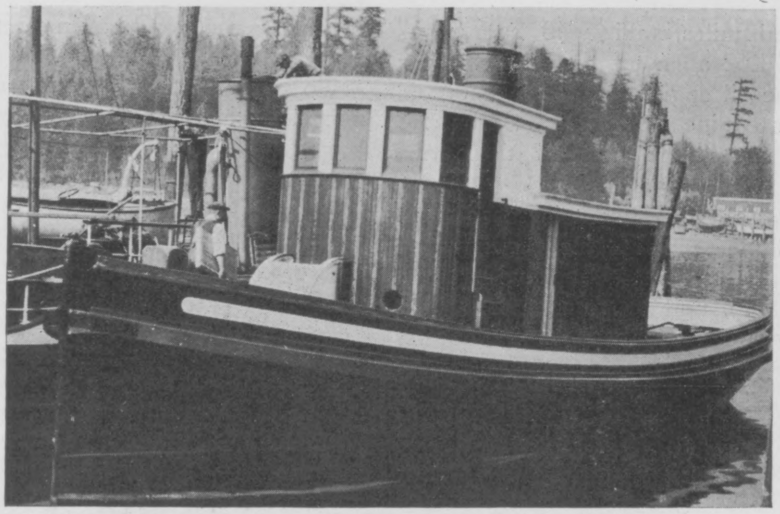
It is not unlikely that this process may make available for Diesels, low-grade fuel oils which are unsuitable in the state in which sold.

It would be a service to Diesel users if you would induce the manufacturers of the apparatus to do some real research work in this line, and publish the results. We have not done anything in this direction, and believe it should not be left to Diesel builders, who would try to keep the results for their own limited benefit.

MAX ROTTER,
Busch-Sulzer Bros. Diesel Eng. Co.,
St. Louis, Mo.

The Motor Liners for the I. M. M.

While we have been advised that the two large motor-liners for the I.M.M.'s Panama-Pacific Line's coast-to-coast run are in embryo state, persistent rumors are to the effect that keels will be laid in March or April for two Diesel-driven ships of 14,000 tons gross and 17 knots speed. The I.M.M., it will be recalled, operates MS. MISSISSIPPI, propelled by twin Harland & Wolf-B.W. engines.



Oil-engined tug "Teeshoe" for pulp and paper mill tows logs, hauls scows, pumps them out, and fights fire

An All-Round Tug

Canadian Concern Adopts American Oil Engine

Recent harbor tests of the Powell River Company's Diesel-driven tug TEESHOE have given a good indication of the varied services which she will be able to render. After having been fitted out with a 110 b.h.p. Union Diesel engine supplied through the Burrard Iron Works of Vancouver, she was put through a series of trials in the presence of a representative party of Vancouver shipping men.

Because of the proper balancing of the engine no undue vibration was noted at the normal running speed of 280 r.p.m. and even when the maximum speed of 320 r.p.m. was attained the vibration was still within reasonable limits.

A clutch is used for maneuvering and a governor automatically maintains the engine speed for which it is set no matter what position the clutch may be in. Setting the governor to give any desired revolutions is accomplished by the pilot and it is possible for him by this means to throttle the engine way down or open it up to the limit with about the same amount of effort on his part as he would need for operating the accelerator of an automobile. In towing work, where the utmost delicacy of control is required for taking up the slack of tow-ropes and for many other reasons, the importance of maneuvering sensitiveness such that which is attained by this method cannot be overestimated.

Auxiliary equipment on the TEESHOE is very complete and consists, in part, of a Union combination gasoline engine and starting-air compressor and a 3-h.p. Fairbanks Morse horizontal gasoline engine driving an electric generator. An especially useful part of the auxiliary machinery on this tug consists of a towing winch driven from shafting belted to a pulley on the forward end of the main engine flywheel. A clutch puts it under the direct control of the operator, who can use it to play in or out rope exactly as required by the various towing and warping operations.

From the same shafting as that which operates the towing winch is driven a 250 g.p.m. rotary pump capable of being connected either to hose-connections for pumping out scows or to a fire-fighting monitor nozzle on deck.

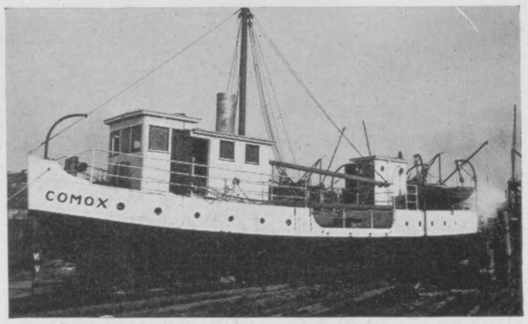
In view of the fact that the Powell River Company operates a large pulp and paper mill located on the banks of the stream, it is almost superfluous to draw special attention to constant usefulness of a tug capable of so many different services. Whether it be towing logs, hauling scows, pumping them out, or fighting fire in the forests or other property along the stream, the never-failing readiness of the oil-engined tug TEESHOE will make her an invaluable addition to the equipment of the company for which she is going into operation.

A Characteristic Workboat

A small but interesting freight and passenger boat known as a camp tender has been built for the Union Steamship Co., of British Columbia, by S. R. Wallace, at North Vancouver, from plans by the Wallace Shipbuilding & Drydock Co., who are located there. The Union Steamship Co. is one of the three largest companies operating in the British Columbia coasting trade, and this is their first Diesel vessel. She is designed to work on some of the long inlets as a feeder to the larger passenger vessels, and is built up to the limit what the coasting regulations allow two men to operate, namely 65 feet o.a. and 55 h.p. The crew will consist of a certified captain and engineer. In the event of her proving the success that is anticipated it is understood that she will be followed by other Diesel vessels of a somewhat larger type.

She is of a type different from those usually seen on this coast, having raised decks forward and aft with a cargo hold amidships.

Principal dimensions of the boat are 65 feet o.a., 63 feet 6 inches l.w.l., 15 foot beam over planking and 5 feet 6 inches loaded draft. She is constructed mainly of fir and cedar, with bent oak frames and gum wood stem and horn timbers.

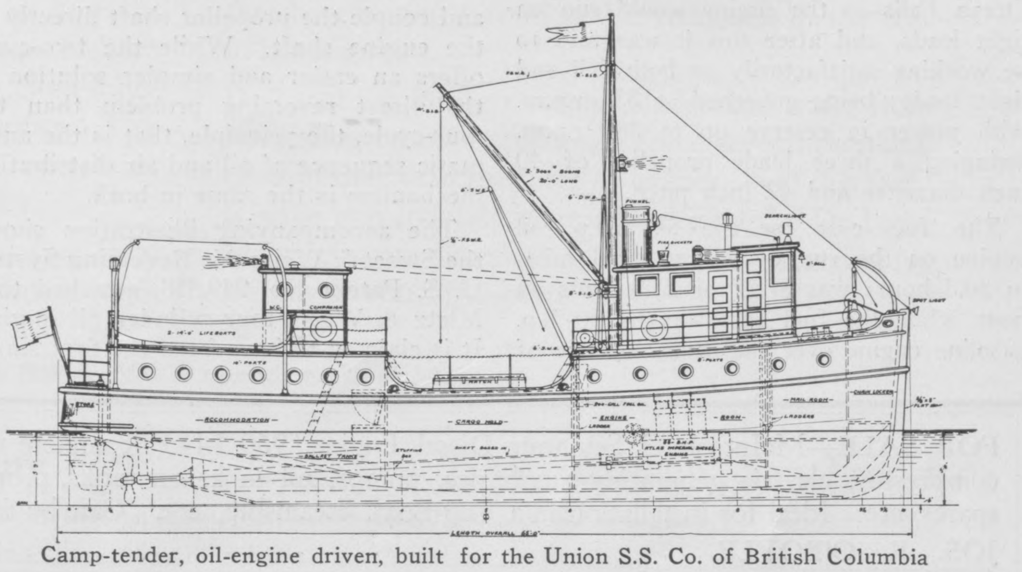


The Union Steamship Co. of New Zealand's new freight and passenger boat "Comax"

Power is furnished by a three-cylinder 4-cycle Atlas-Imperial Diesel engine developing 55 b.h.p. at 325 r.p.m. and weighing 9,500 lbs., including the clutch, but not the other fittings, tanks, or auxiliaries. An Atlas gasoline-driven compressor unit is available for pumping up starting air in case it should be needed, but under normal conditions the main engine pumps its own air.

7½ to 1 in Favor of Oil Engine

An interesting comparison between a heavy-duty gasoline engine and a newly installed oil engine of about the same power is reported from the Forestry Department power cruiser EUCLETAW operat-



Camp-tender, oil-engine driven, built for the Union S.S. Co. of British Columbia

ing on the British Columbia coast. The Forestry Department operates a large fleet of small craft on inspection work and fire protection duties, and last year started on a programme of installing oil engines of both Diesel and surface-ignition types in new boats; and also where replacement of gasoline engines was considered necessary.

The EUCLETAW is 54 feet over all by 11 feet 5 inches beam, and was previously equipped with a three-cylinder 50 b.h.p. gasoline engine. This was replaced at Vancouver by a two-cylinder 10¾ inches by 11½ inches 54 b.h.p. Vickers-Petters surface-ignition oil engine developing its power at 325 r.p.m.

She left Vancouver for Ocean Falls making the run of 137 miles to Thurston Bay in 13½ hours the first day, and 240 miles to Ocean Falls the next day in 22 hours and 50 minutes; the total running time being 36 hours and 20 minutes, and the total distance scaled on the chart of 377 statute miles. This trip is figured by masters of steamers on that run to be 379 statute, or 337 nautical miles, which gives an average speed of about 10.4 statute miles, or a little better than 9 knots, which was considered a very satisfactory performance. On the trip down from Ocean Falls with the 50 h.p. gas engine the time taken is said to have been 40 hours with more favorable winds and tides.

It is stated that the fuel consumed by the 54 b.h.p. oil engine on the trip north averaged three imperial gallons of Star fuel (about 24 to 28 degrees Beaume) per hour at 7¼ cents per gallon, a total of 110 gallons costing $7.97. Fuel consumed on the trip south with the previous engine (50 b.h.p. heavy-duty) was 240 gallons of 50/50 distillate and gasoline costing $64.80; or 40 hours at 6 gallons per hour, costing 27 cents per gallon. No note had been made of the lubricating oil used when southbound, and when running north with a new engine no attempt was made to economise in the use of it. It was noted that there was less vibration than with the old engine, there being no effect on handwriting in making up the log. Some adjustments were reported made at Ocean Falls so the engine would run on light loads, and after this it was said to be working satisfactorily on both full and light loads; being governed at 335 r.p.m. with power in reserve up to 360 r.p.m. swinging a three blade propeller of 40 inch diameter and 42 inch pitch.

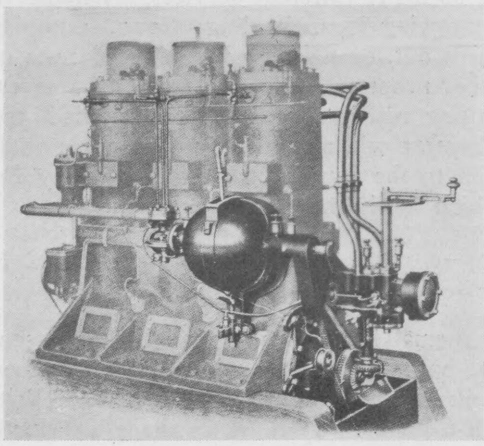
The fuel cost for the 54 b.h.p. oil engine on the run of 337 nautical miles in 36.3 hours was $7.97 or 21.9 cents an hour while the fuel cost for the 50 h.p. gasoline engine over the same distance of 337 nautical miles, taking 40 hours was $64.80 or 71.62 an hour, the fuel cost per mile for the oil engine being 2.4 cents and for the gas engine 18.1 cents. Seven and a half to one is the ratio of these two costs.

The Forestry Department is reported to be so well pleased with the performance of this oil engine that they have ordered another 54 h.p. unit to go in a new boat about 62 feet o.a. by about 12 foot beam.

The Sweet and Weiss Reversing System

In the early days of the marine internal-combustion engine, the one great advantage claimed for its competitor, the steam engine, was control. The stored energy in the boiler and the necessary valve mechanism of the engine made starting in either direction of rotation positive and perfectly reliable. It was convenient, of course, for the steam advocate to overlook the fact that boilers are normally not containers of stored energy unless certain well-known combustion means are constantly maintained to make them so.

In the application of small powers to pleasure or work boats, the simple reversible blade propeller, and the reversing gear are reliable and durable. For more than 100 h.p., however, it becomes necessary to discard all intermediate mechanism, and couple the propeller shaft directly to the engine shaft. While the two-cycle offers an easier and simpler solution of the direct reversing problem than the four-cycle, the principle, that is the automatic sequence of oil and air distributing mechanism is the same in both.



Oil-engine with Sweet & Weiss Reversing system

The accompanying illustration shows the Sweet & Weiss Air Reversing System U. S. Patent No. 949,858, attached to a Mietz & Weiss four-cylinder oil engine. It is claimed to have been the first single lever control for starting and reversing engines of the oil-injection type.

To manipulate an engine reliably it is necessary in the first place to have a sufficient volume of compressed air. The air must be distributed to the cylinders with great precision, and at the proper angular position of the crankshaft. The fuel must be shut off prior to the air admittance and must remain so until the engine has completed one revolution or one complete cycle under air pressure either forward or astern.

The Sweet & Weiss system was designed to carry out these necessary movements in proper order by a single control lever. The air enters directly in front of the reversing air valve through an air strainer, removably attached to a small shallow cylinder. The upper and lower stem of the reversing valve are keyed to the control lever and oil control cam respectively. The oil control cam operates the oil by-pass segment, geared to a pinion which is held in frictional engagement with the air distributing valve stem. The air distributing valve is geared to the engine shaft in 1:1 ratio and is set angularly in relation to the cranks so that the air enters the cylinders in proper sequence at the upper dead center of the pistons for either direction of rotation. In the central position of the control lever the air is shut off. A short movement to the right or left opens the oil by-pass through the cam segment and the oil injections to the engine cease. A further movement of the lever admits air through the reversing valve to the distributing valve and cylinders.